Science@School | Book 5F

Changing sounds

Teacher's Guide

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The pupil book explained unit by unit

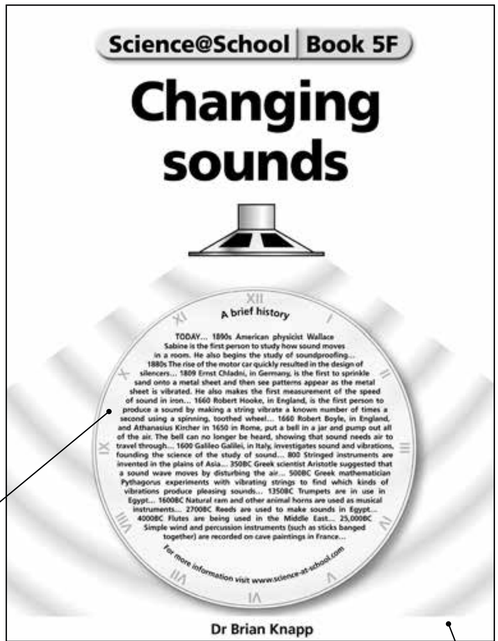
Although the pupil book – *Changing sounds* – is clear and simple, a great deal of care and thought has been given to the structure and the content of each double page spread or unit. The worksheets and activities in this *Teacher's Guide* also link directly to the pages in *Changing sounds*.

It is possible to use *Changing sounds,* and the worksheets and activities, without reading this section, but we would strongly recommend that you take a short time to familiarise yourself with the construction of the pupil book.

The units are arranged in sequence, to help you with your lesson planning. In this section, a brief description of the content of each unit is given, together with hints on how to start or support it. List 1 (Starting a unit with a demonstration) on page 11 sets out the resources that you could use to do the demonstrations where suggested. The activity associated with each unit is also briefly described to help you see how the unit and activity work together.

Title page

The book begins on the title page (page 1). Here you will find information about science and technology in the form of a clock. You may want to use this to set the scene for the study of the book's contents. You may choose to focus on an event which ties in with your work in history, before moving onto the rest of the book. Alternatively, you may wish to skip over this page and return to it later. It is not a core part of the book, but helps the children see how the work they are doing now fits in with the work of scientists and engineers in the past. It may also be used to stimulate more able pupils to research the people and events that are described here.



A time clock giving additional historical information about the topic.

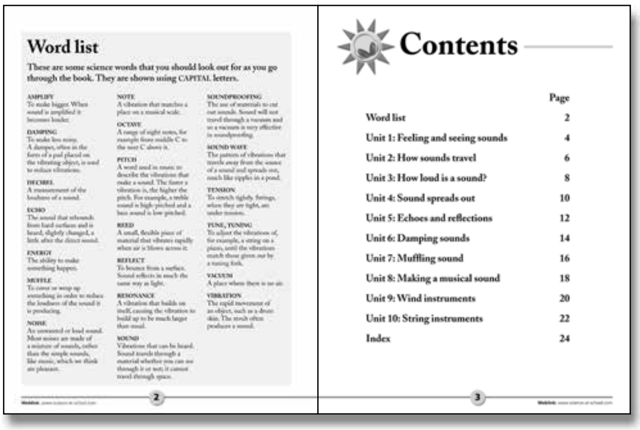
This picture shows a graphic representation of sound waves spreading out from a loudspeaker, and consisting of compressions and expansions of air that match the vibrations of the speaker.

Word list and contents

The core content of the book begins with a word list on page 2. This is a glossary, brought to the front for the pupils' attention. Pupils could be encouraged to look at the list and see how many of the words they already recognise.

One of the important things about science is the precision with which words are used. However, many scientific words are also common words, often used in a slightly different way from how they would be used in science. The word list presents the opportunity for pupils to consider the words they already know, and the meanings they are familiar with.

When your teaching unit has been completed, you may want to invite pupils to revisit this list and see if their understanding of the words has been enhanced or changed in any way. A visual dictionary is also given on the CD.


Word list

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The entire contents are shown on page 3. It shows that the book is organised into double page spreads. Each double page spread covers one unit.

The units

Heading and introduction

Each unit has a heading, below which is an introductory sentence that sets the scene and draws out the most important theme of the unit.

Body

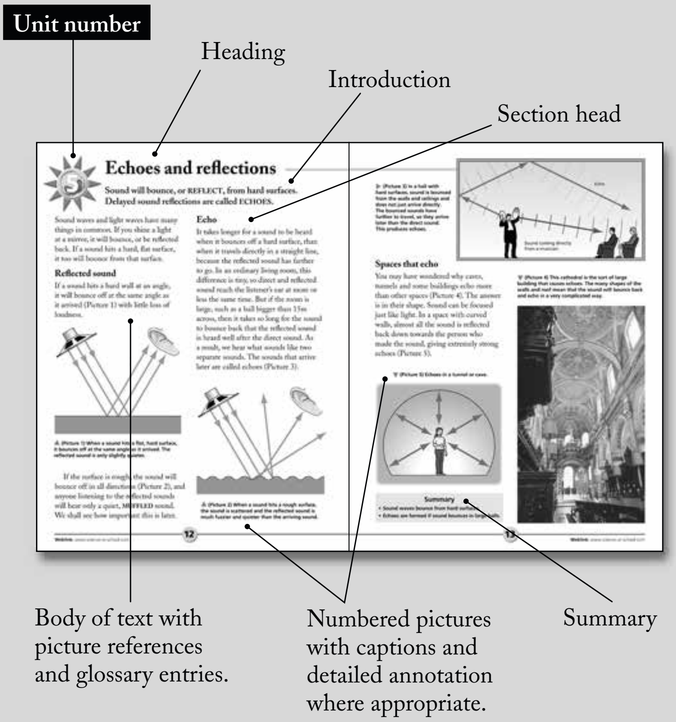
The main text of the page then follows in a straightforward, easy-to-follow, double column format.

Words highlighted in bold capitals in the pupil book are defined in the word list on page 2. A visual dictionary is also given on the CD.

The glossary words are highlighted on the first page on which they occur. They may be highlighted again on subsequent pages if they are regarded as particularly important to that unit.

Summary

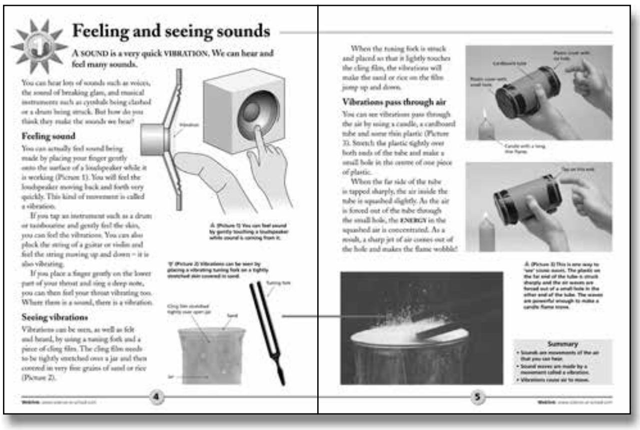
Each unit concludes with a summary, highlighting and reinforcing the main teaching objectives of the unit.



1 Feeling and seeing sounds

You may like to begin by setting yourself up as a one-person band. You could do this by playing a kazoo, strumming a guitar and beating a base drum or tapping gently on a tambourine with your foot. When the children have had enough, ask them about how the different sounds were made and look for blowing, plucking and beating. Now tell the children that all the sounds were made by vibrating objects. Tell the children that they have a vibrating object inside them which makes their voices, and ask them to press on their voice boxes and sing a range of notes with you from low to high and back again.

The unit begins by explaining that sounds are movements in the air that you can hear. This is followed by a description of a wide range of sound sources. The link between sound and vibrations is made by describing what happens when you put a finger on a loudspeaker while it is working. This is followed by showing how the effect of a vibration can be clearly seen when a vibrating tuning fork is applied to a taut piece of cling film covered in sand.



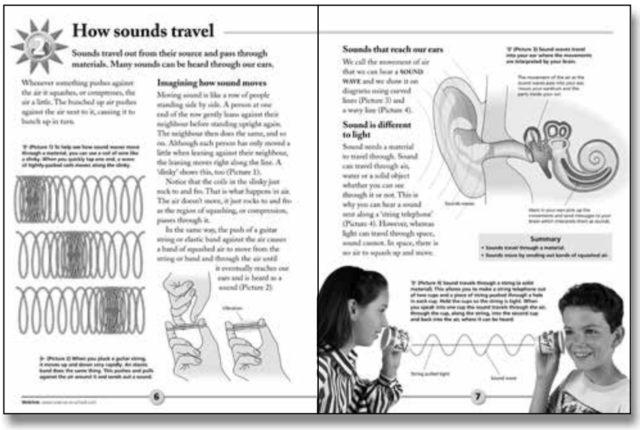
The unit ends by demonstrating how the movement of a sound wave can be concentrated so much that it can blow out a candle.

In the complementary work, the children make a sound quiz using a cassette recorder, and use secondary sources to find out how a loudspeaker and a microphone work. In the activity, the children plan and carry out a sound survey around the school.

2 How sounds travel

You may like to begin by sticking thread to a table tennis ball with a piece of sticky tape. Hang the ball in the air from one hand and remind the children that all matter – solids, liquids and gases – is made from tiny particles, and this table tennis ball represents a particle of air. Now strike a tuning fork and bring one of its tines up so that it just touches the ball. The ball should swing away, then return, and keep bouncing off the tine. Tell the children that the vibrating tine is causing the backwards and forwards movement of the particle and that is what every vibrating object does to the particles around it.

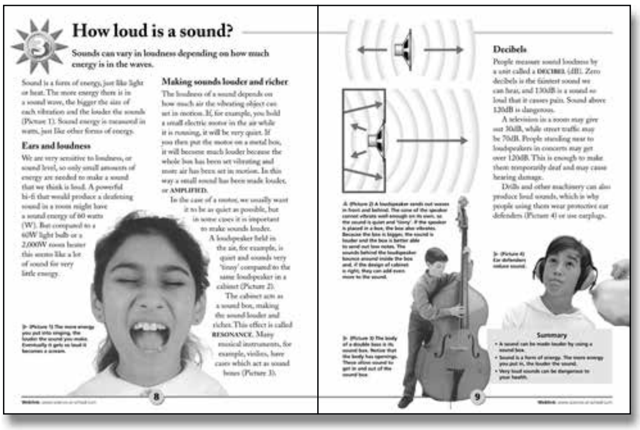
This unit builds on the previous one by showing what happens to a sound wave after it has been produced by a vibration. The difficult concept of dealing with vibrating air particles is made easy to understand by inviting the children to stand in a line and behave as air particles. A slinky is used to show how sound waves move through any material. The movement of sound is compared to the movement of



light, and the unit ends by describing the passage of sound through a string telephone.

In the complementary work, the children make and use a three-way string telephone, and use secondary sources to find out how a real telephone works. In the activity, the children find out how sounds travel through solids, water and air.

3 How loud is a sound?

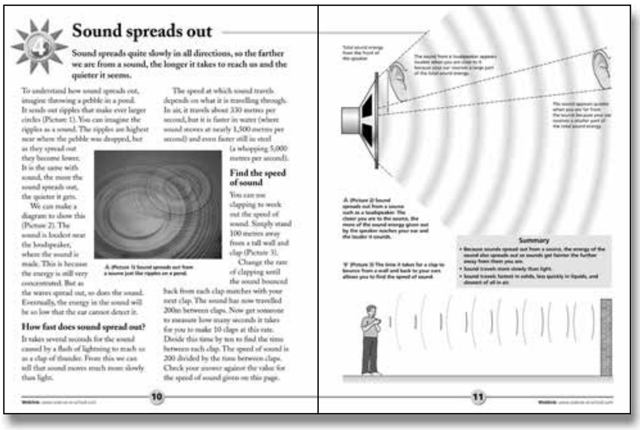


Group the children around a piano. While they are looking at it, take a metal tray, hold it above your head and then let it go. When the children have recovered from the loud sound, pick up the tray, hold it above your head and ask the children what they thought had happened. If they are unsure, let the tray go again. Tell the children that the tray had moving energy as it fell but when it hit the ground some of the energy changed into another form - sound energy. Show the children the power of sound energy by removing the top of the piano and singing a note into it. Some of the strings should resonate, and the children should hear a sound from the piano.

This unit begins by introducing the idea that sound is a form of energy, like light and heat. The text then moves on to relate the amount of energy in a sound wave to its loudness. A comparison is made between a quiet sound, which is produced when only a small amount of air is set in motion, and a loud sound, which is produced when a large amount of air is set in motion. The terms amplification and resonance are introduced in relation to making loud sounds. It is revealed that only a small amount of energy is needed to make sounds we can comfortably hear, and the unit ends by introducing the decibel scale to measure the loudness of sounds.

In the complementary work, you can make a model to show how vibrations and waves are related, and the children can make a sound survey at home. In the activity, the children find out how resonance produces loudness, and make a survey using a decibel scale.

4 Sound spreads out



You may like to begin by taking the class into the hall and asking them to sit by the back wall. Stand in front of them quite close and talk to them. Keep your voice at the same loudness and slowly walk backwards across the hall. When you reach the other end walk back again, still talking at the same loudness and ask the children what they heard. Look for an answer about the sound becoming quieter as you went away and becoming louder as you came back. You could ask one or more children to test the result by playing recorders at different distances from the class.

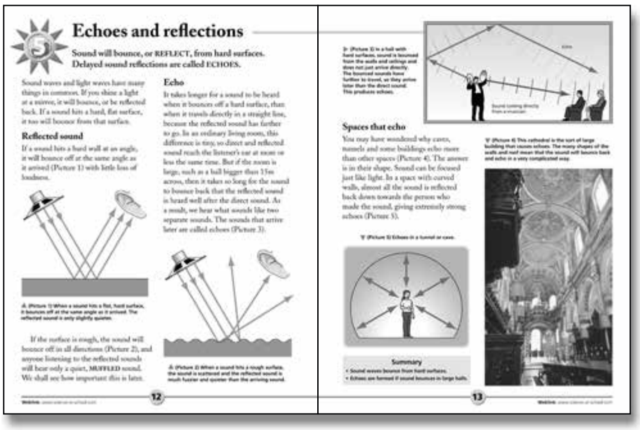
This unit builds on the previous units by showing how a sound spreads out from its source. The unit begins with a photograph of ripples on water, and discusses how sound waves spread out through air in a similar way. This is followed by an explanation of how the strength of sound waves falls as they spread out and how this affects the loudness of a sound as it moves into the distance. The time between seeing lightning and hearing thunder is described, and used to introduce the children to how sound waves travel at different speeds in different materials. The unit ends by inviting the children to perform their own investigation to find the speed of sound in air.

In the complementary work, the children find out what happens when a vibrating tuning fork is put in water, and also find out about how the sound varies around a battery powered radio. In the activity, the children investigate ways to control how sound spreads out.

5 Echoes and reflections

You may like to begin by asking who sings in the bath. Be prepared about anecdotes of other family members who sing in the bath. Ask the children why they think people sing in the bath and look for answers about voices sounding better. Ask them why voices do not sound the same in all rooms of the house, and help the children towards an answer about hard smooth surfaces reflecting sound. Remind the children that sounds move as waves, and show them how a wave moves along a flicked rope which is tied at one end. Show them that the wave travels both ways along the rope – it is reflected.

This unit begins by describing the reflection of light, then explains that sound waves can be reflected too. The text then moves on to show that a hard, smooth surface reflects sound more powerfully than a rough surface. This comparison is supported by clear diagrams showing the paths of sound waves both before and after they have been reflected. The reflection of sound is extended to consider how sound waves produce echoes in a large hall and a cave.

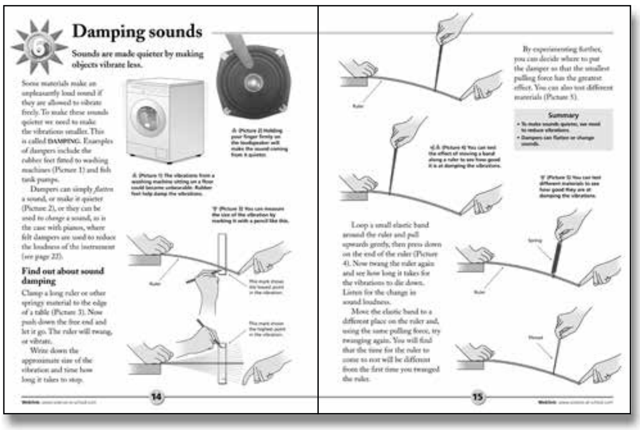


In the complementary work, the children find out how sounds can be reflected from the back of a book, and look at a model to see how different surfaces absorb different amounts of sound energy. In the activity, the children investigate how sounds are reflected and how an echo can be made.

6 Damping sounds

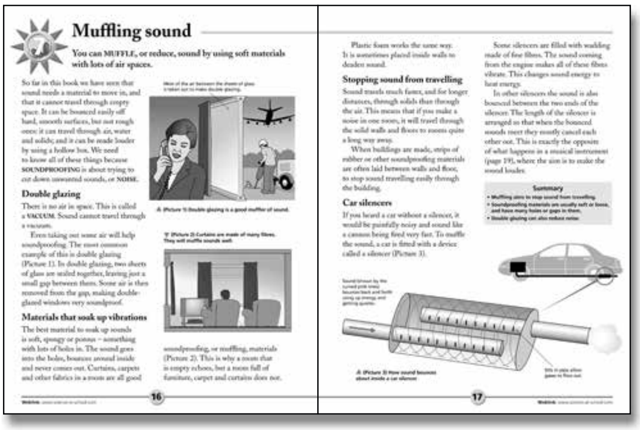
You could begin by asking the children to take a ruler and place one end of it under a book, with most of the ruler hanging over the end of their desk or table. Ask the children to strike the end of the ruler and describe what they see and hear. In their answers, look for linking the words vibration and sound. Now ask them to drape a handkerchief or similar cloth over the ruler and strike it again. This time they should see than the ruler does not vibrate as strongly and stops vibrating sooner, and that the sound is less noisy and ends sooner. Tell the children that they have reduced the sound of the ruler by a process called damping.

This unit reinforces some of the earlier units by linking sounds with vibrations. It shows how holding a finger on a loudspeaker that is working can reduce the vibrations and produce damping of the sound. The role of dampers in the piano is briefly discussed, then a simple experiment is described and illustrated which invites the children to make their own observations about how a vibration can be reduced.



In the complementary work, the children find out how the sound of a drum can be damped using different materials, and how a cymbal may be damped by touching it. In the activity, the children make a scientific model to show how damping affects sound waves and how different materials can be used to cause damping.

7 Muffling sound


Muffling sound

You can MUFFLE, or reduce, sound by using soft materials with lots of air spaces.

Double glazing

Materials that soak up vibrations

Stopping sound from travelling

Car silencers

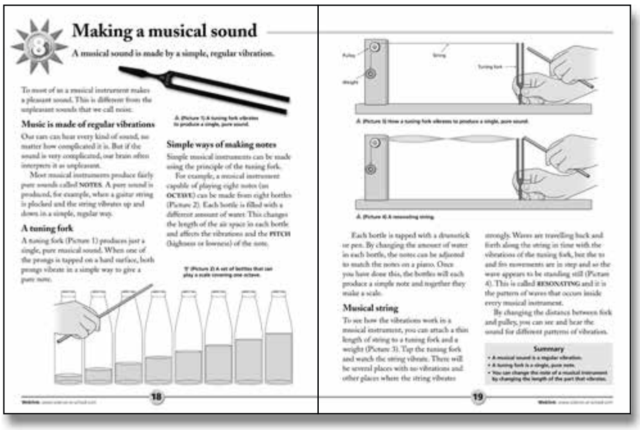
Summary

You may like to begin by talking to the children with a hand, or handkerchief, over your mouth. Reduce the volume of your voice until the children have difficulty hearing you. Remove the object from in front of your mouth and ask where the vibration that made your voice comes from to make your voice. Look for an answer about the voice box or vocal cords. Ask the children why they had difficulty hearing you before. Look for an answer about the object reducing the power of the sound waves. Tell the children that although it was inappropriate to muffle your voice when you were speaking, there are times when using materials to muffle sound is very useful indeed.

This unit starts by reviewing what the children have learned in the previous units and shows that a knowledge of sound production is essential for making soundproofing devices. The text then moves on to describe how the structure of a double-glazed window pane reduces the amount of sound passing through it. This is followed by a description of the role of soft furnishing, such as carpets and curtains, in reducing sounds in a room. The way that sound travels through solids is described, and this information is linked to the movement of sound through walls of a building. The unit ends with an illustrated account of how a car silencer works.

In the complementary work, the children find out about people who use ear protection in their work, and how an anechoic chamber is used to test sound-making devices. In the activity, the children make a full investigation to compare how different materials muffle sound.

8 Making a musical sound


Making a musical sound

A musical sound is made by a simple, regular vibration.

Music is made of regular vibrations

A tuning fork

Simple ways of making notes

Musical string

Summary

You may like to begin by making a scraping noise, such as dragging a chair across the floor. When you have finished, sit on the chair and play some low notes on a recorder. Ask the children how they think the sounds are different. Look for answers about the scraping sound being lots of high-pitched sounds mixed up, while the sound from the recorder seems to be made of fewer different sounds. Tell the children that there are special machines which record sounds and display the sound waves on a screen. Draw some zig zag lines on the board and tell the children that this is what the sound of scraping looks like. Draw some gentler, rounder waves which are not as high as the zig zag waves and tell the children these are like the waves from a musical instrument.

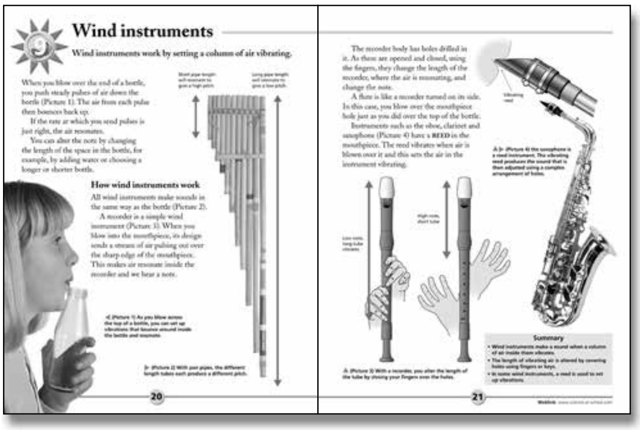
This unit begins by asking what the difference is between the sound waves that form music and those that make noise. A noise is a sound wave that is produced by complicated vibrations, while a musical note is produced by much simpler vibrations. The way that a tuning fork produces a pure sound, called a note, is described, then the text moves on to explain how a row of bottles can be used to produce an octave. By examining the accompanying diagrams and studying the instructions, the children can then make their own investigations of a resonating string.

In the complementary work, the children find out about ancient instruments, instruments from around the world and how pitch is related to vibrations. In the activity, the children investigate musical notes made by balloons, bottles and straws.

9 Wind instruments

If you have some children in the class who play recorders or other wind instruments they may like to put on a short performance to introduce this unit. At the end of the performance you could ask them how they make low- and high-pitched notes and how they make loud and soft notes. They could respond by demonstrating and explaining their techniques. Finish by reminding all the children that the notes are produced by the air inside the instrument, which vibrates when a player blows into it.

In the previous unit, the children learned that they could produce a musical note when they tapped a bottle that was partially filled with water. This unit begins by showing how a note can be produced by blowing over the open end of a bottle. The text accompanying the illustration explains how a loud pure note is produced. In the following section, it is revealed that all wind instruments work in the same way – they have a means of sending vibrations into a tube and a way of adjusting the tube length so different notes can be made. The unit ends by comparing how a note is made in a flute and an oboe.

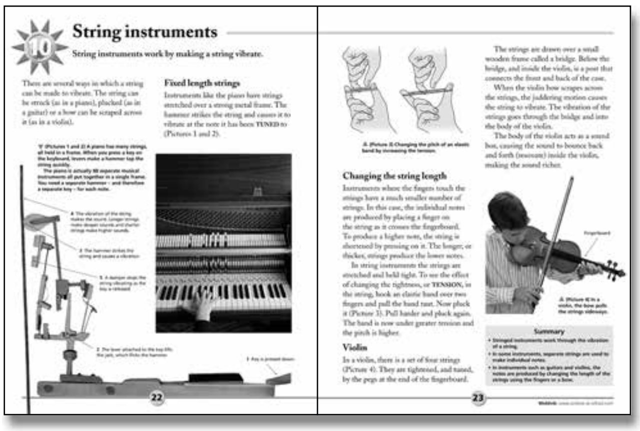


In the complementary work, the children find out about wind instruments in the orchestra. In the activity, the children make a simple wind instrument and explain how it works.

10 String instruments

If you have some children in the class who play a violin, piano or other stringed instrument they may like to put on a short performance to introduce this unit. At the end of the performance you could ask them how they make low- and high-pitched notes and how they make loud and soft notes. They could respond by demonstrating and explaining their techniques. Alternatively, you could ask a parent who is a good musician to come in to school and play for the children, and explain how they could begin to learn the instrument.

This unit complements the previous unit by showing how music is made on a stringed instrument. The unit opens by explaining that a string may be struck, plucked or scraped to produce a note. The piano, with its huge range of strings of different lengths, is compared with other stringed instruments, which have fewer strings yet produce a wide range of notes by changing the lengths of their strings. An intriguing photograph shows the mechanism that links a piano key to its string, while the unit ends by describing the way a violin vibrates to produce a note.



In the complementary work, the children find out about the stringed instruments in the orchestra. In the activity, the children investigate how the length, thickness and the tension in an elastic band affect the note it makes.

Index

There is an index on page 24.

Using the pupil book and photocopiable worksheets

Introduction

There is a wealth of material to support the topic of changing sounds in the pupil book and in the *Teacher's Guide*. On this and the following three pages, suggestions are made on how to use the worksheets and their associated teacher's sheets, and how to integrate them for lesson planning. On the page opposite you will find the resource lists for introductory demonstrations, the complementary work and the activity worksheets. The learning objectives are shown on pages 12 and 13.

Starting a unit

Each unit in the pupil book forms the basis for a lesson. You may like to start by reading it with the class, or begin with a demonstration (see List 1 on page 11). Always begin the unit by reading the introductory sentences in bold type. This helps focus the class on the content of the unit and to prepare them for the work.

The first part of the main text introduces the content, which is then developed in the headed sections. The illustrations are closely keyed to the main text, and the captions of the illustrations develop the main text content.

With less skilled readers, you may prefer to keep to the main text and discuss the illustrations when they are mentioned. With more skilled readers, you may want to let them read the captions for themselves. Each unit ends with a summary. The children can use this for revision work. They can also use it to test their understanding by trying to explain the points made in the summary.

You can find the learning objectives for each unit

The style and content of the unit also make it suitable for use in literacy work, where the needs of both English and science are met. You may wish to use the unit as a topic study in literacy work, or you may want to perform an activity in science time and follow it up with a study of the unit during literacy work.

Using the comprehension worksheets

Each unit in the pupil book has one photocopiable comprehension worksheet in this *Teacher's Guide* to provide a test. The learning objectives for these comprehension worksheets relate directly to the knowledge and understanding component of the science curriculum.

The comprehension worksheets begin with simple questions and have harder questions towards the end.

The worksheets may be used singly, after each unit has been studied, or they may be used along with other worksheets to extend the study.

The teacher's sheet, which is opposite the comprehension worksheet, shows the answers and background information to the unit. This teacher's sheet also carries a section on work complementary to the study topic. This work may feature research using other sources. It may also have value in literacy work.

Using the activity worksheets

The activities are designed to develop skills in scientific enquiry. The learning objectives for practical skills associated with each unit are given. The activities may be small experiments, may focus on data handling or comprise a whole investigation.

Each activity section is a double page spread in this *Teacher's Guide*. On the left hand page is a photocopiable activity worksheet to help the children in practical work, or it may contain data for the children to use or interpret. The page opposite the worksheet is a teacher's sheet providing a step-by-step activity plan to help you organise your work. Each plan has a set of notes which provide hints on teaching or on the use of resources. The activity plan ends with a conclusion, which you may like to read first, to help you focus on the activity in your lesson planning.

Planning to use a unit

The materials in this pack are very flexible and can be used in a variety of ways. First, look at the unit and activity objectives. Next, read the unit in the pupil book, and the associated worksheet and activity units in this *Teacher's Guide*. Finally, plan how you will integrate the material to make one or more lessons. You may wish to add more objectives, or replace some of the activity objectives with some of your own.

Safety

The practical activities feature equipment made from everyday materials or available from educational suppliers.
However, make sure you carry out a risk assessment, following the guidelines of your employer, before you do any of the practical activities in either the pupil's book or the *Teacher's Guide*.

Resources

The three lists below show the resources needed to support the photocopiable worksheets.

- ▶ List 1 shows resources for demonstrations suggested for starting a unit.
- ▶ List 2 gives resources needed for the complementary work featured on the teacher's sheet associated with each comprehension worksheet.
- ▶ List 3 details those resources needed for the 10 activity worksheets.

List 1 (Starting a unit with a demonstration)

▼ UNIT

1. Kazoo, guitar, drum and beater pedal or tambourine.
2. Table tennis ball, thread, sticky tape, tuning fork.
3. Metal tray and piano.
4. School hall, recorders (optional).
5. A rope with one end tied to a support.
6. Each child will need a ruler and a handkerchief or similar piece of cloth.
7. Handkerchief (optional).
8. Chair, recorder.
9. Group of musicians from the class who play wind instruments.
10. Group of musicians from the class who play stringed instruments, or a visitor who plays one or more stringed instruments.

List 2 (Complementary work)

Each group will need the following items:

▼ UNIT

1. (a) A cassette recorder, items to make a sound quiz, access to parts of the school to make a sound quiz.
(b) Secondary sources about how loudspeakers and microphones work.
2. (a) Three yoghurt pots, three burned matchsticks, three pieces of string, sticky tape. (b) Secondary sources about how telephones work.
3. (a) Yoghurt pot with small hole in the bottom, string handle, piece of string, long piece of old wallpaper, sand.
(b) Information about the decibel scale to take home.
4. (a) Tuning fork, bowl of water. (b) A battery powered radio, a large space in which to place the radio and walk round it.
5. (a) A hard-backed book.
(b) A tennis ball, a metal tray, a cushion.
6. (a) A selection of cloth materials of different sizes, a drum such as a tom tom or a snare drum, a pair of drum sticks. (b) A cymbal and a drum stick.
7. (a) Secondary sources about people who wear ear protection for their work.
(b) Secondary sources about anechoic chambers (see page 43 for explanation).
8. (a) Secondary sources about musical instruments in history. (b) Secondary sources about musical instruments from around the world.
(c) Bowl of water.
9. Secondary sources about wind instruments in the orchestra.
10. Secondary sources about stringed instruments in the orchestra.

List 3 (Activity worksheets)

Each group will need the following items:

▼ UNIT

1. Locations around the school which have a range of noise levels and different sources of noise.
2. A clock or battery operated radio (never use a radio plugged into the mains), air-filled balloon, water-filled balloon, piece of wood, bowl, two metal spoons, water, balloon pump (optional).
3. Piece of wood, elastic band, pencil, bowl, vacuum cleaner for teacher demonstration (optional), locations around the school which have a range of noise levels and different sources of noise.
4. An open space, a clock with a loud tick or a humming computer, a piece of card, scissors, sticky tape, tape measure or metre rule, cassette recorder or microcassette recorder used for dictation.
5. Two, long cardboard tubes, a sheet of card, a ticking clock, a wall with at least eighteen metres of open space on flat ground.
6. A rope and chair, a large tin with a lid (for example, a biscuit tin), pencil or chopstick, selection of objects, including weights, balls, cloths, drum such as a snare drum (optional).
7. A selection of materials such as a blanket, bubble wrap, artificial fur, sheets of foam, a cardboard box (optional), sticky tape, a clock, battery powered radio, battery powered buzzer, ruler.
8. A balloon, a bottle, a pencil, a straw.
9. A bottle, a straw, five more straws, scissors, two pieces of card and sticky tape (optional).
10. A piece of wood with a drawing pin in it, a long elastic band, two pencils, a hook, a yoghurt pot with string handle, marbles or masses (optional), several elastic bands of the same length but different thicknesses – all of them capable of stretching round the piece of wood and two pencils. Check school safety policy to see if eye protection is needed.

Learning objectives

Comprehension worksheets

The table below shows the learning objectives for knowledge and understanding associated with each unit in the pupil book, using the comprehension worksheets in this *Teacher's Guide*:

Unit 1

- ▶ Sound waves are made by vibrations.
- ▶ Vibrations cause movement in the air.

Unit 2

- ▶ Movement of sound is called a sound wave.
- ▶ Sound waves travel through materials.
- ▶ Sound waves are different from light waves.

Unit 3

- ▶ Sounds can be amplified.
- ▶ Sound is a form of energy.
- ▶ The loudness of a sound is measured in decibels.

Unit 4

- ▶ A sound gets fainter as it spreads out from its source.
- ▶ Sound travels more slowly than light.
- ▶ Sounds can travel through solids, liquids and air.

Unit 5

- ▶ Sound waves can be reflected.
- ▶ A hard surface is a better sound reflector than a rough surface.
- ▶ Some reflected sounds are called echoes.

Unit 6

- ▶ An object can make sound when it vibrates.
- ▶ If an object's vibrations are reduced, less sound is produced.
- ▶ A sound is damped when the vibration of an object is reduced.

Unit 7

- ▶ Muffling aims to stop sound from travelling.
- ▶ Soundproofing materials muffle sound.
- ▶ Soundproofing materials are soft and spongy or have air spaces in them.

Unit 8

- ▶ A musical sound is a regular vibration.
- ▶ A noise is a complicated vibration.
- ▶ The note of a musical instrument is changed by changing the length of the vibrating part.

Unit 9

- ▶ A column of air vibrates in a wind instrument to make a note.
- ▶ Holes or keys on a wind instrument control the length of the column of vibrating air.
- ▶ A reed is used in some wind instruments.

Unit 10

- ▶ The strings in a stringed instrument vibrate to produce the notes.
- ▶ The pitch of the note is changed by changing the length of the vibrating string.
- ▶ Strings may be struck, plucked or scraped to make them vibrate.

Learning objectives

Activity worksheets

The table below shows the learning objectives for practical skills associated with each unit in the pupil book, using the activity worksheets in this *Teacher's Guide*:

Unit 1
- Plan an investigation.
- Construct a table.
- Draw conclusions from results.

Unit 2
- Use simple equipment and materials safely.
- Record results in written form.
- Compare the results of two experiments.

Unit 3
- Repeat an experiment to check results.
- Make a prediction and test it.
- Plan and carry out an investigation.

Unit 4
- Suggest explanations for observations.
- Find a pattern in results.
- Devise and make a simple piece of equipment to test experimental results.

Unit 5
- Follow instructions.
- Make careful observations.
- Record results in the form of a diagram.

Unit 6
- Make and use a scientific model.
- Make comparisons.
- Make careful observations.

Unit 7
- Make and test predictions.
- Construct a fair test.
- Carry out a fair test.
- Draw conclusions from results.

Unit 8
- Make predictions.
- Use knowledge and understanding to explain predictions.
- Make careful observations.

Unit 9
- Make careful observations.
- Explain predictions using knowledge and understanding.
- Use simple equipment safely.

Unit 10
- Plan and carry out a fair test.
- Recognise patterns in data.
- Use evidence from three investigations to make a general statement about the results.

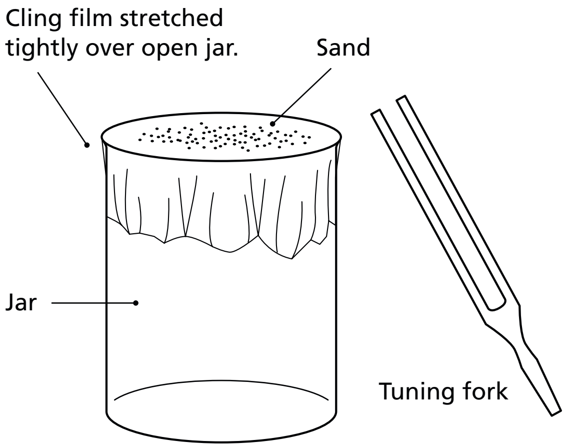
1

Name: .... Form: ....

See **pages 4 and 5** of *Changing sounds*

Feeling and seeing sounds

A sound is a very quick vibration. We can hear and feel many sounds.



Q1. The picture shows a tuning fork and a jar with a cling film top covered in sand.

(i) In the space next to the picture, draw another picture showing how you would place the tuning fork against the jar after you have struck the tuning fork.

(ii) In your picture, draw how the sand grains would appear when the vibrating tuning fork touches the cling film.

Q2. If you put a finger on a loudspeaker while it is working what would you feel?

✎ ....

Q3. Which part of your body vibrates when you make a low note?

✎ ....

Q4. Imagine you have a tube with a plastic cover on one end and a cover with a small hole in it at the other end.

(i) When you tap the end with no hole, what happens at the hole in the other end?

✎ ....

(ii) If a burning candle was placed near the hole and the cover tapped again, what would happen to the candle? Explain your answer.

✎ ....

✎ ....

Teacher's sheet: comprehension

See **pages 4 and 5** of *Changing sounds*

Answers

1. **(i) One of the tines of the tuning fork would touch the cling film; (ii) Some sand grains should be shown in the air.**
2. **The loudspeaker moving backwards and forwards very quickly (the vibrations).**
3. **Your throat.**
4. **(i) A sharp jet of air comes out; (ii) The candle flame would wobble. The jet of air causes the flame to wobble.**

Complementary work

(a) The children could use a cassette recorder to make a sound quiz by recording a wide range of everyday sounds, or sounds from around the school which others can then try to identify.

(b) The children can use secondary sources to find out how loudspeakers and microphones work.

Teaching notes

It may well be that the children have not done any formal science work on sound since they were in infant classes. They may however have picked up some ideas about sound from work in music, so at the beginning of this unit it is essential to find out what the children know about sound and to identify any misconceptions that they have.

Sound is produced by vibration. This can be a to and fro, or up and down, movement of an object. An object vibrating in air pushes and pulls on the air close to it, and this makes the air vibrate. This vibrating air then pushes and pulls on the air next to it, and this makes the air next to it vibrate. This vibrating air pushes and pulls on the air next to it, and so on. Each part of the air only vibrates a little, but passes the vibration on to the next part of the air. The vibration passes through the air and is called a sound wave. It is important to stress that the air close to a vibrating object does not pick up the sound wave and carry it through the air.

Some children may ask how we hear a sound. They could be told that in the ear is a very thin piece of skin called the ear drum. When a sound wave reaches the ear drum it causes the ear drum to vibrate. This vibration then passes through three small ear bones (the smallest bones in the body, called the hammer, the anvil and the stirrup) which act as levers to strengthen the vibration so it can be detected by nerves inside the ear. The nerves then inform the brain that a sound has been detected.

1

Name: .... Form: ....

Based on **pages 4 and 5** of *Changing sounds*

What are the sounds?

Try this...

1. What are the sounds that can be heard in different parts of the school? Plan an investigation to find out.

✎ ....

✎ ....

✎ ....

✎ ....

2. Make a table in which to record your results.

3. Show your teacher your plan. If your teacher approves, try your investigation.

Looking at the results.

4. What do your results show?

✎ ....

✎ ....

5. How could you make your investigation more thorough?

✎ ....

1 Teacher's sheet: activity

Based on **pages 4 and 5** of *Changing sounds*

Introducing the activity

(a) You may use this activity either before or after the children have read pages 4 and 5 in the pupil book. You may like to begin by asking the children to sit in silence to listen to what sounds there are when no one is speaking (see note (i)).

Using the sheet

(b) Give out the sheet, let the children fill in their names and form, then go through tasks 1 and 2 (see note (ii)).

(c) Let the children try tasks 1 and 2.

(d) Let the children try task 3 (see note (iii)).

(e) Go through task 4, then let the children try it (see note (iv)).

(f) Let the children try task 5 (see note (v)).

Completing the activity

(g) Let the children compare their results.

Conclusion

The sounds that are produced around the school may be simply surveyed by going to different locations and listening for a few minutes. A list of sounds can be constructed for each place, and the sounds categorised according to whether they were long and continuous, of short duration, loud or quiet, high-pitched or low-pitched.

Teaching notes

(i) Be prepared for any children who may wish to make sounds of their own to amuse the others and stress the need for sensible behaviour. Let the children listen only for a short time so that some may say they did not have enough time. Tell the children to think about the amount of time they need for listening when they are making their survey about sounds around the school.

(ii) Tell the children that they should think about how they are going to record their results as they make their plan. It may actually help them make their plan.

(iii) The plan should include visiting different places around the school and listening at each place for a few minutes. Children may suggest listening with their eyes shut as this helps to focus on the sense of hearing. The children may simply record the sounds at each place or categorise them into loud or quiet sounds. Some may categorise sounds into high- or low-pitched. The table should have one column for locations and one or more columns to categorise the sounds.

(iv) Some children may need help to sort out which were quiet places and which were noisy places.

(v) The children may suggest spending longer in each place or visiting it at different times of day.

2

Name: .... Form: ....

See **pages 6 and 7** of *Changing sounds*

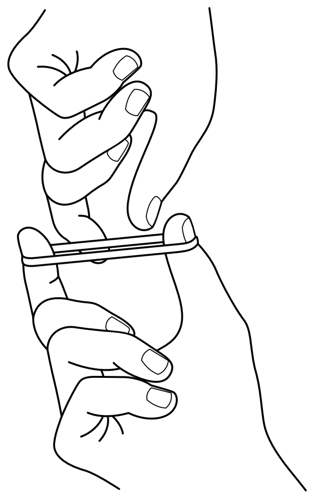
How sounds travel

Sounds travel out from their source and pass through materials. Many sounds can be heard through our ears.

Q1. The picture shows a finger about to pluck an elastic band.

(i) In the box, draw what happens to the elastic band after it has been plucked.

(ii) What does the elastic band do to the air around it?



✎ ....

✎ ....

Q2. What is a slinky? ✎ ....

Q3. What happens when you quickly tap one end of a slinky?

✎ ....

✎ ....

Q4. What do we call a movement of air that we can hear? ✎ ....

Q5. Name a place where light can travel but sound cannot. ✎ ....

Q6. (i) When you use a string telephone, can the string between the cups be left slack or must it be taut?

✎ ....

(ii) When you use a string telephone, how does the sound get from your mouth to your friend's ear?

✎ ....

✎ ....

✎ ....

2 Teacher's sheet: comprehension

See **pages 6 and 7** of *Changing sounds*

Answers

1. **(i) The elastic band should be drawn moving up and down; (ii) It causes a band of squashed air to move through the air.**
2. **A coil of wire.**
3. **A wave of tightly packed coils moves along the slinky.**
4. **A sound wave.**
5. **Space.**
6. **(i) The string must be taut; (ii) It goes through the air in your cup, along the string and through the air in your friend's cup.**

Complementary work

(a) The children could make string telephones, as featured on page 7 of the pupil book. They could then add a third 'line' to the string telephone and see if a third person can join in. This should work if the strings are kept taut.

(b) The children can use secondary sources to find out how a telephone works.

Teaching notes

From their work on materials, the children may be aware that materials can be divided into three groups – solids, liquids and gases – and that all the substances in these groups are made from tiny particles. It is important for the children to realise that these particles are much smaller than the particles of sand and dust they can see, and that in fact a grain of sand is made up from millions of tiny particles of matter.

When a solid object, such as a ruler, vibrates, the particles in it are also vibrating. In solids, the particles are held firmly and close together, but can still move a little. This means that when a solid vibrates, its particles can spread the vibration quickly through the material. Sound is a form of energy, and in a solid less energy is used to make the particles vibrate, so the strength of the sound does not decrease quickly as the sound wave passes through a solid. In a liquid, the particles are held less securely and more energy is used to make them vibrate. This means that sounds travel slower and lose their power more quickly in liquids than in solids.

In a gas the particles are free to move about. This results in sound travelling much slower in gas (air is a mixture of gases) than in a liquid or a solid.

Sounds cannot travel in space because there are not enough gas particles to transport the vibrations.

2

Name: .... Form: ....

Based on **pages 6 and 7** of *Changing sounds*

Does sound travel through different materials?

Try this...

1. Collect a clock with a loud tick or turn on a battery operated radio.

2. Put an inflated balloon next to the sound source.

3. Press your ear gently against the balloon on the side furthest from the sound source and listen.

4. Place a balloon filled with water next to the sound source, press your ear against the balloon and listen again.

5. Place one end of a piece of wood on the sound source.

6. Put your ear on the other end of the piece of wood and listen.

7. Write a report of what you heard in this investigation.

✎ ....

✎ ....

✎ ....

8. What can you conclude from the investigation?

✎ ....

9. Hold two metal spoons inside an empty bowl and tap them together.

10. Fill the bowl with water and tap the spoons together underwater.

11. What differences did you notice about the sound of the spoons in steps 9 and 10?

✎ ....

12. Do your observations support any conclusions? Explain your answer.

✎ ....

✎ ....

Teacher's sheet: activity

Based on **pages 6 and 7** of *Changing sounds*

Introducing the activity

(a) You may use this activity before or after the children read pages 6 and 7 in the pupil book.

Remind the children that there are three kinds of materials – solids, liquids and gases, and their task is to find out if sound travels through all of them.

Using the sheet

(b) Give out the sheet, let the children fill in their names and form, then go through task 1 (see note (i)).

(c) Let the children try task 1.

(d) Go through tasks 2 and 3, then let the children try them (see note (ii)).

(e) Go through task 4, then let the children try it (see note (iii)).

(f) Go through tasks 5 and 6, then let the children try them.

(g) Let the children try task 7.

(h) Let the children try task 8.

(i) Go through tasks 9 and 10, then let the children try them.

(j) Let the children try tasks 11 and 12.

Completing the activity

(k) Let the children compare their results.

Conclusion

The sound of the clock or radio may be heard faintly through the balloon filled with air. The sound of the clock or radio may be heard more loudly through the balloon filled with water. The sound of the clock or radio is loudest when heard through the wood.

The two metal spoons made a tinny, clinking noise when tapped in the air in the bowl.
The spoons made a deeper, louder sound when tapped underwater in the bowl. These observations support the observations made with the air-filled and water-filled balloons.

Teaching notes

(i) Do **NOT** use a radio connected to the mains.

(ii) If the children have the appropriate ability and attitude, they could blow up the balloon themselves with a pump. The children do not need to write anything down until they have completed task 6.

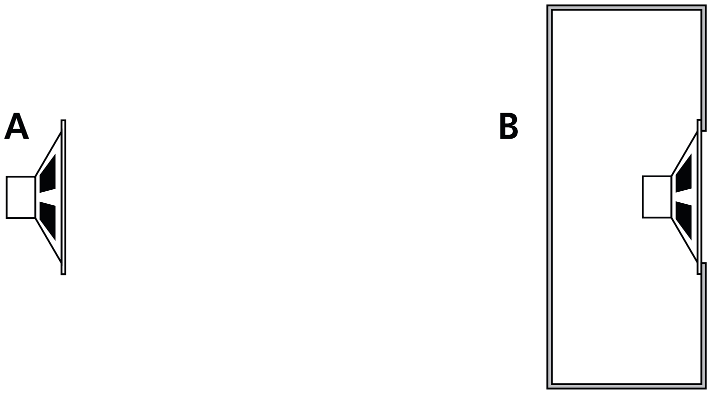
(iii) If the children have the appropriate ability and attitude, they could fill the balloon with water themselves. The children do not need to write anything down until they have completed task 6.

Name: .... Form: ....

See **pages 8 and 9** of *Changing sounds*

How loud is a sound?

Sounds can vary in loudness depending on how much energy is in the waves.



Q1. (i) Draw how the sounds spread out in front of loudspeaker A when it is working.

(ii) Draw how the sounds spread out in front of loudspeaker B when it is working.

(iii) Why is there a difference in the sound waves produced by the two loudspeakers?

✎ ....

Q2. (i) Name two other forms of energy besides sound energy.

✎ .... ✎ ....

(ii) What are the units used to measure sound energy? ✎ ....

Q3. What happens to a sound when it is amplified?

✎ ....

Q4. Which part of the violin is the soundbox? ✎ ....

Q5. (i) What is the unit used to measure the loudness of sounds? ✎ ....

(ii) How can very loud sounds affect people?

✎ ....

Q6. What should a person wear if they are operating a drill? Explain your answer.

✎ ....

✎ ....

Teacher's sheet: comprehension

See **pages 8 and 9** of *Changing sounds*

Answers

1. **(i) The waves spreading out as shown on page 9 of the pupil book; (ii) The waves spreading out as shown on page 9 of the pupil book; (iii) The box around loudspeaker B sends out sound waves too.**

2. **(i) Light and heat; (ii) Watts.**

3. **It is made louder.**

4. **The case.**

5. **(i) Decibels; (ii) Cause pain, cause temporary deafness or cause permanent hearing damage.**

6. **Ear defenders or ear plugs. The drill makes such a loud sound that it may cause pain or harm the person's hearing.**

Complementary work

(a) You may like to demonstrate the relationship between a vibration and a wave form in the following way. Make a small hole in the bottom of a yoghurt pot and attach a string handle to the yoghurt pot. Attach a long piece of string to the yoghurt pot, through the hole, to make it into a pendulum. Place one end of a long sheet or roll of paper (such as wallpaper) under the yoghurt pot.

Now fill the yoghurt pot with sand, raise it above the paper and start it swinging. This represents a vibrating object. Move the paper along under the swinging yoghurt pot. Waves will be made by the stream of sand on the paper.

(b) The children could do the decibel survey at home at different times of the day.

Teaching notes

Children sometimes confuse loudness with pitch. Loudness is related to the amount of movement made by a vibrating object, and thus the amount of movement in the surrounding material that carries the sound wave away.

If an object makes a small vibration (for example, a ruler which is gently twanged), the object pushes and pulls only weakly on the surrounding material (for example, air). These weak pushes and pulls cause the particles of matter in the surrounding material to move only a short distance when they move to and fro. This can be thought of as producing sound waves with small crests and troughs, like the waves blown by a breeze across a pond. The small movements of the vibrating object and the particles in the surrounding material produce a quiet sound.

If an object makes a large vibration, the object pushes and pulls strongly on the surrounding material. These strong pushes and pulls cause the particles to move further as they swing to and fro. This can be thought of as producing sound waves with high crests and deep troughs like those seen in a stormy sea. The large movements of the vibrating object and the particles in the surrounding material produce a loud sound.

Information on pitch is found on page 47.

In the introduction to this unit you may have sung into a piano. This is an example of resonating. Further information on resonating is found on page 55.

Name: .... Form: ....

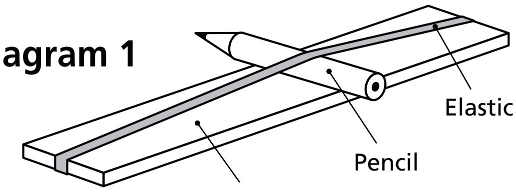
Based on **pages 8 and 9** of *Changing sounds*

Investigating loudness

Try this...

1. Set up an elastic band and a pencil on a piece of wood as Diagram 1 shows.

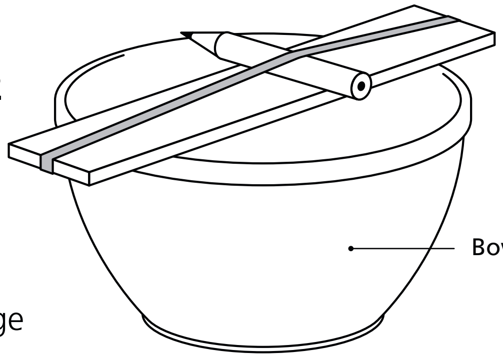
Diagram 1



2. Pluck the elastic band.

3. Now place the wood over an empty bowl as Diagram 2 shows.

Diagram 2



4. Pluck the elastic band again.

5. How did the sound of the elastic band change when you placed the wood over the bowl?

✎ ....

6. How could you check your answer to step 5? Predict what might happen.

✎ ....

7. Check your answer to step 6. How did your prediction compare with the result?

✎ ....

8. Here are some sounds and their loudness on the decibel scale.

Road drill: 110dB

Vacuum cleaner: 80dB

Normal speech: 50dB

Whisper: 30dB

A sound that can just be heard: 10dB

On a separate sheet, plan an investigation into the loudness of sounds around the school. Show your plan to your teacher. If your teacher agrees, carry out your investigation.

9. What do your investigations show?

✎ ....

3

Teacher's sheet: activity

Based on **pages 8 and 9** of *Changing sounds*

Introducing the activity

(a) You may like to begin by getting the children to be silent, then whisper, then use their normal speaking voices, then shout, then speak more quietly, until they are silent again. Tell them that as they spoke they used different loudness of their voices, and in this activity they have two investigations to make about the different loudness of sounds.

Using the sheet

(b) Give out the sheet and let the children fill in their names and form, then go through task 1 and let the children try it.

(c) Go through task 2, then let the children try it.

(d) Go through tasks 3 and 4, then let the children try them.

(e) Let the children try task 5.

(f) Let the children try tasks 6 and 7 (see note (i)).

(g) Go through task 8, then let the children try it (see note (ii)).

(h) Let the children try task 9.

Completing the activity

(i) Let the children compare their results.

(j) You may like to play a violin, then cover up the opening on the front to show how the sound is changed when the sound box is stopped from working.

Conclusion

When an elastic band is plucked on a piece of wood it makes a quiet sound. When the wood is placed over a bowl and the elastic band is plucked again, a louder sound is made.

The loudness of sounds varies in different parts of the school.

Teaching notes

(i) The children should be aware of the need to repeat experiments to check the results. This activity gives you an opportunity to check how well they realise that experiments can be checked by repeating them.

(ii) You may like children to see if they can hear a pin drop, then whisper, and then talk at normal speech. You could finish by switching on a vacuum cleaner so the children have some idea of the loudness of some sounds and their decibel value.

If the children have done activity 1, you may like to return to the results they obtained there. You could then let the children repeat activity 1, but this time estimate the loudness of the sounds in each place they visit.

4

Name: .... Form: ....

See **pages 10 and 11** of *Changing sounds*

Sound spreads out

Sound spreads quite slowly in all directions, so the farther we are from a sound, the longer it takes to reach us, and the quieter it seems.

Q1. On the picture, draw the path of the sound waves when the man claps his hands.

Q2. (i) When you throw a pebble in a pond, what shape do the ripples make?

✎ ....

(ii) Where are the ripples highest?

✎ ....

(iii) How does the height of the ripples change?

✎ ....

Q3. What happens to the energy in a sound wave as the sound waves spread out?

✎ ....

Q4. What is the name of the sound made when lightning flashes? ✎ ....

Q5. (i) A sound travels in air, then in water and finally into a solid. How does its speed change?

✎ ....

✎ ....

(ii) Far in the distance, you see a person hit a fence post with a mallet, but you do not hear any sound. After a moment, you hear the sound of the mallet hitting the fence post. Why?

✎ ....

Teacher's sheet: comprehension

See **pages 10 and 11** of *Changing sounds*

Answers

1. **The path may be shown by an arrow going from the person to the wall and an arrow going from the wall back to the person. Or, it may be shown as a series of curved sound waves going in each direction.**

2. **(i) Ever larger circles; (ii) Near where the pebble was dropped; (iii) They get lower as they spread out.**

3. **It gets lower.**

4. **Thunder.**

5. **(i) It gets faster when it enters the water and faster again when it enters the solid; (ii) Light travels faster than sound.**

Complementary work

(a) Ask the children to predict what would happen if you struck a tuning fork, then dipped a vibrating tine in water. When this activity is performed they should see waves move across the surface of the water. There may also be some splashes.

(b) The children could, in turn, put a sound source such as a battery powered radio, in the middle of a large space, then walk away, and back, to show how sound changes with distance. They could walk a little distance from the sound source, then try to walk round it and keep the same level of sound reaching their ears. They should find that they walk round the object in a circle.

Teaching notes

If you throw a pebble into a puddle, waves spread out across the surface in all directions. This suggests that the wave is a real object that rushes across the surface. If a little boat is put in the puddle, and another pebble is dropped in, you may expect the wave to rush along and carry the boat with it to the edge of the puddle. This does not happen. The boat simply bobs up and down as the wave passes by. The motion of the boat gives a clue to what is happening in the water. The particles from which the water is made simply move up and down when the pebble is thrown into the water, and this up and down movement is seen as a wave moving across the surface of the puddle.

In a similar way, a sound wave is not a wall of compressed gas which pushes its way through the air. It is made by the movement of particles as they swing to and fro over a small distance. The vibrating object causes the particles of air next to it to swing to and fro. These particles then push on particles next to them and start them swinging. In this way the movement (we call it a sound wave) passes through the particles, but the particles only travel a little way to and fro themselves.

Sound is a form of energy, and as the particles vibrate they use some of the energy. This explains why sound dies away as it travels further from the source. The energy has simply been converted to motion by all the vibrating particles, so there is less sound energy left to make the ear drums vibrate.

4

Name: .... **Form:** ....

Based on **pages 10 and 11** of *Changing sounds*

Controlling the spread of sound

Try this...

1. Go into an open space and ask a friend to stand at least ten metres away.

2. Start talking to your friend and, keeping your voice at the same loudness, cup your hands around your mouth.

3. Now ask your friend to repeat what you have done.

4. How did cupping the hands affect the sound of your voices?

✎ ....

5. Suggest a reason for what you heard.

✎ ....

6. Stand in front of a ticking clock or a humming computer. Listen to the sound.

7. Cup your hands behind your ears and pull your ears slightly forward. How does the sound change?

✎ ....

8. Suggest a reason for what you heard.

✎ ....

✎ ....

9. In the box, draw a simple device you could make which would help people be heard over a distance and could also help people hear very quiet sounds.

10. Explain how the device could be used.

✎ ....

✎ ....

11. Show the teacher your device, and if your teacher approves, make it and test it. How successful is the device?

✎ ....

4 Teacher's sheet: activity

Based on **pages 10 and 11** of *Changing sounds*

Introducing the activity

(a) You may like to begin by explaining that sound is made by vibrating objects, which produce sound waves that travel through the air. Tell the children that a vibrating object in water also produces sound waves, and show them a tray full of water. Wiggle a finger at one end of the tray to represent a vibrating object, and let the children see the waves spread out through the water. Tell the children that they are going to study how waves travel through the air, but it may help them if they think of the sound waves moving like the waves in the water.

Using the sheet

(b) Give out the sheet and let the children fill in their names and form. Go through tasks 1 to 4 and let the children try them.

(c) Let the children try task 5.

(d) Go through tasks 6 and 7, then let the children try them.

(e) Let the children try task 8.

(f) Go through tasks 9 and 10 with the children (see note (ii)).

(g) Let the children try tasks 9 and 10.

(h) Let the children try task 11 (see note (iii)).

Completing the activity

(i) Let the children compare their results.

(j) If you have a cassette recorder, or a micro-cassette recorder used for dictation purposes, you may ask the children how they could use them to test their devices to find if a person can be heard more clearly from a distance (see note (i)).

Conclusion

When the hands are cupped over the ears, a voice can be heard over a greater distance. This is due to the sound waves being prevented from completely spreading out. When the ears are cupped, the sound from an object is heard more loudly and clearly because the cupped ears collect waves that are spreading out and direct them into the ears.

A cone of card can be used to improve hearing.

Teaching notes

(i) This could be set as a separate task for children who have the appropriate ability and attitude, if it is in accordance with your school safety policy.

(ii) A simple device, which will serve as both a megaphone and an ear trumpet, can be made from a card shaped into a cone.

(iii) To test if the cone helps people hear better over distances, a sound-recording device can be set up at different distances from a person who talks normally, then uses a megaphone.

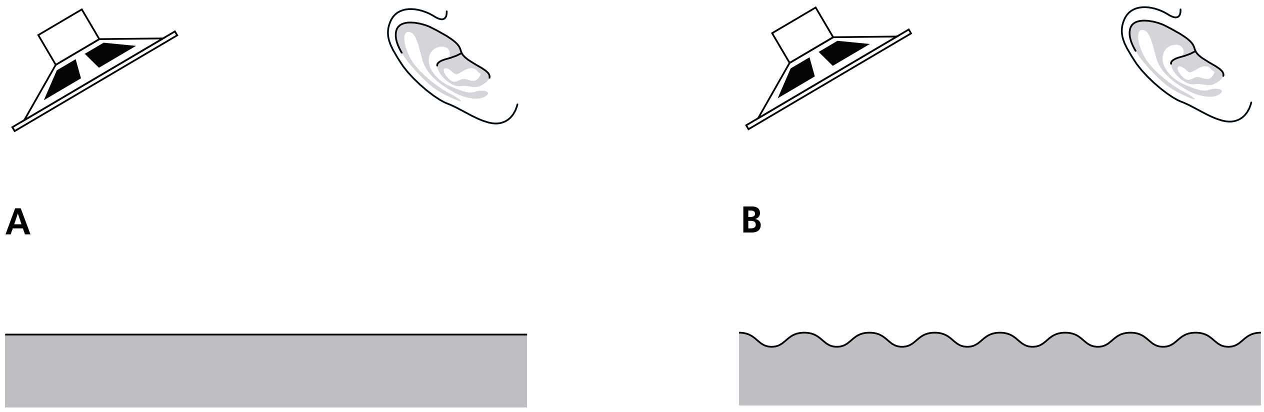
5

Name: .... Form: ....

See **pages 12 and 13** of *Changing sounds*

Echoes and reflections

Sound will bounce, or reflect, from hard surfaces. Delayed sound reflections are called echoes.



A **B**

Q1. (i) In Picture A, draw in the path of the sound waves that travel from the loudspeaker to the ear.

(ii) In Picture B, draw in the path of the sound waves that travel from the loudspeaker to the ear.

(iii) How are the surfaces different in A and B?

✎ ....

Q2. In which picture, A or B, are the largest reflected sound waves made? ✎ ....

Q3. In which picture, A or B, will the reflected sound waves be less clear than the original sound? ✎ ....

Q4. If you sit at the back of a large hall and listen to someone at the other end play the cymbals, why do you hear two sounds?

✎ ....

✎ ....

✎ ....

Q5. Name two places where very strong echoes can be heard. Explain your answer.

✎ ....

✎ ....

✎ ....

Teacher's sheet: comprehension

See **pages 12 and 13** of *Changing sounds*

Answers

1. **(i) The sound waves all leave the surface at the same angle and their paths are parallel; (ii) The sound waves leave the surface at different angles and their paths go in different directions; (iii) A is smooth and B is rough.**

2. **A.**

3. **B.**

4. **One sound comes directly through the air to you from the cymbals. The other sound goes from the cymbal and is reflected by the walls and ceiling.**

5. **Caves and tunnels. The walls are curved and focus almost all the reflected sound back to the person who made the sound.**

Complementary work

(a) Ask the children to get a hard-back book and hold it about 20 centimetres in front of them. Ask them to lower the book below their faces and start making a steady “arh“ sound. Now ask them to raise the book until it is in front of their faces. They should hear the sound become louder, due to some of the waves being reflected off the surface of the book. If they move the book below their faces again, they should hear their “arh” sound becoming slightly fainter.

(b) Show the children a tennis ball and a tray. Tell them that the ball represents an air particle and the tray represents a hard surface. Hold the tray and ask someone to throw the ball at it. This represents a particle in a sound wave striking the surface. Note what happens to the ball. Now repeat the activity with a cushion instead of a tray. The cushion represents the surface of a soft material. See how the material soaks up the energy of the ball and prevents it from bouncing back.

Teaching notes

The human ear can only hear two separate sounds if they reach the ear more than a tenth of a second apart. This means that for the reflection of a sound to be heard, it must reach the ear one-tenth of a second after the source of the sound.

In the activity on page 36, the sound of the reflection from the wall must reach the ear at least one-tenth of a second after the sound of the clap from the hands. Sound travels at about 330 metres per second, or 33 metres in one-tenth of a second. If a child stands about 17 metres from the wall, the clap and the echo will be heard because the sound from the clap will have travelled 17 metres towards the wall and 17 metres back again.

The children may have heard about echo location in bats. These animals produce high-pitched sounds (called ultrasonic sounds) that we cannot hear. These sounds behave in the same way as the sounds we can hear. The bats use the echoes of these ultrasounds to find food.

5

Name: .... Form: ....

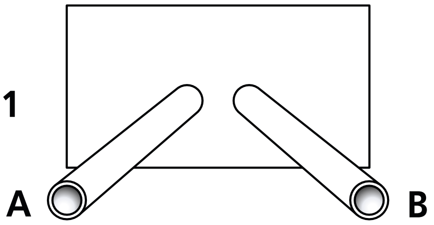
Based on **pages 12 and 13** of *Changing sounds*

Investigating the reflection of sound

Try this...

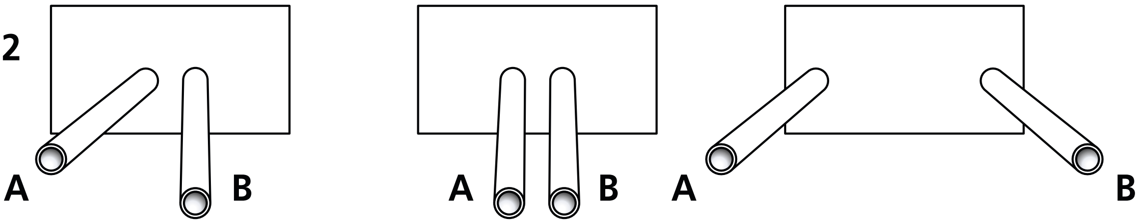
1. Set up a sheet of card and two long cardboard tubes as shown in Diagram 1. Put a loud ticking clock in front of tube B. Then put your ear close to the end of tube A and listen for the sound of the clock.

Diagram 1



2. Move the tubes to different positions, such as those shown in Diagram 2. Keep the clock in front of tube B.

Diagram 2



3. After you have set up the pair of tubes in a certain position, put your ear to tube A and listen to the sound.

4. Change the position of the tubes and listen again.

5. Keep repeating step 4 until you find the position of the tube which makes the ticking clock sound loudest.

6. Draw the arrangement of the tubes which made the clock sound loudest.

7. Go to a wall which has a large open space next to it.

8. Stand one metre from the wall, clap your hands and listen for an echo.

9. Step back one metre, clap your hands again and listen for an echo.

10. Repeat step 9 until you hear an echo. How far are you from the wall when you hear an echo?

✎ ....

Teacher's sheet: activity

Based on **pages 12 and 13** of *Changing sounds*

Introducing the work

(a) If the children have done the activity in the previous unit, ask them what they thought happened to the sound waves that left their mouths and hit the sides of the megaphone. Look for an answer about reflection. Ask them about how an ear trumpet collects sound, and look for an answer that includes the sound waves striking the inside of the ear trumpet and being reflected down into the ear.

Using the sheet

(b) Give out the sheet, let the children fill in their names and form. Go through task 1 and let the children try it.

(c) Go through tasks 2 and 3, then let the children try them (see note (i)).

(d) Go through task 4, then let the children try it.

(e) Go through task 5, then let the children try it (see note (ii)).

(f) Let the children try task 6 (see note (iii)).

(g) Go through tasks 7 to 10, then let the children try them (see note (iv)).

Completing the activity

(h) Let the children compare their results.

Conclusion

The clock is heard the loudest when the tubes are pointing to the sheet of card at the same angle, but in different directions. When the tubes are arranged like this, the angle at which the sound is reflected from the surface is the same as the angle of the sound which strikes it. This relationship between the two angles is also found when light is reflected from a flat mirror.

An echo can be heard when the child is 17 metres from the wall (an explanation for this is given on page 35).

Teaching notes

(i) Some children may have difficulty in organising themselves to make the sequence of observations required. They may need to be taken through the sequence step-by-step. You may like to demonstrate how to make the sequence of tasks from steps 2 to 5.

(ii) Some children may think they only have to set up the tubes in the positions shown on the sheet. Remind them to think of other arrangements and try them.

(iii) Some children may wish to use a protractor, but this is not essential. The diagram should show that tube A and tube B point at the same angle to the sheet but in different directions.

(iv) There needs to be a space of at least 17 metres in front of the wall where the child can walk. This is best done in a quiet place, with one child, or pairs of children working together, at the wall while the rest of the class are doing other things.

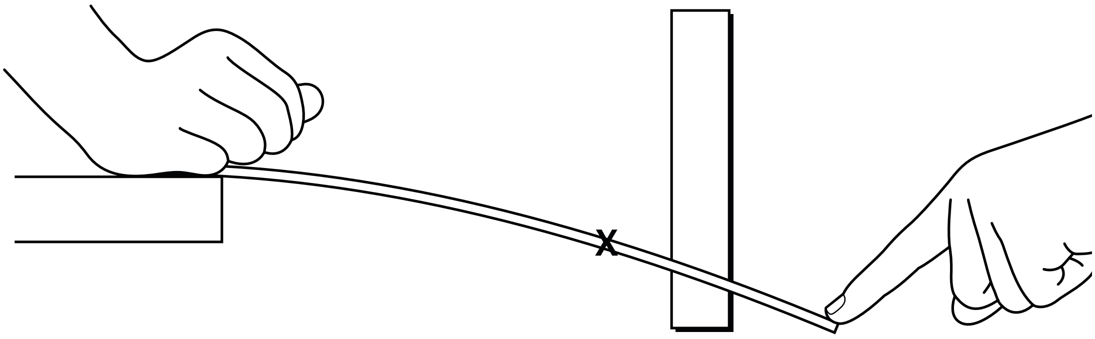
6

Name: .... Form: ....

See **pages 14 and 15** of *Changing sounds*

Damping sounds

Sounds are made quieter by making objects vibrate less.



Q1. The diagram shows the end of a ruler held down by a finger.

What will happen to the ruler when the finger is removed?

✎ ....

Q2. What will happen if an elastic band is held gently in place around the ruler at point X, and the finger is then removed from the end of the ruler?

✎ ....

✎ ....

Q3. What happens if you hold your finger firmly on a loudspeaker as it makes a sound?

✎ ....

Q4. Why is there a change in the sound when you put your finger on the loudspeaker?

✎ ....

Q5. Name a machine fitted with dampers that can be found in the home.

✎ ....

Q6. (i) What instrument has felt dampers? ✎ ....

(ii) What do the dampers do to the instrument?

✎ ....

6 Teacher's sheet: comprehension

See **pages 14 and 15** of *Changing sounds*

Answers

1. **The ruler will spring up and down, or vibrate.**
2. **The ruler will not spring up or down, or vibrate, as much.**
3. **It goes quiet.**
4. **The loudspeaker vibrates less.**
5. **Washing machine or fish tank pump. (Also dishwasher, vacuum cleaner, spin drier.)**
6. **(i) Piano; (ii) Reduce its loudness.**

Complementary work

(a) The children can find out how different materials can damp the sound of a drum.

(b) The children could study the effect of touching a cymbal after it has been struck to see how its ringing sound is damped.

Teaching notes

The process of damping a sound occurs at the object that is vibrating. This can be compared with muffling a sound, which is a process of absorbing sound once it is moving through a material.

The damping process is widely used with percussion instruments. When some drums are hit they make a ringing sound because the drum resonates when it is struck. This makes the sound linger on. Drums are used to provide a definite beat so other musicians can keep time. An imprecise beat, provided by a lingering sound, is difficult to follow so many drums, especially bass drums, have a damper. This is a piece of felt held on a bracket inside the drum. A screw control on the side allows the damper to be pressed against the drum skin to reduce its vibrations and give a crisp beat.

Percussionists also use the damping process with some cymbals. Many cymbals are designed to produce a lingering note which gradually fades away. Sometimes only a crisp smash with the cymbal is needed. The crisp smash is made by hitting the cymbal then touching it straight afterwards. The fingers on the cymbal damp the vibration and the sound fades very quickly.

6

Name: .... **Form:** ....

Based on **pages 14 and 15** of *Changing sounds*

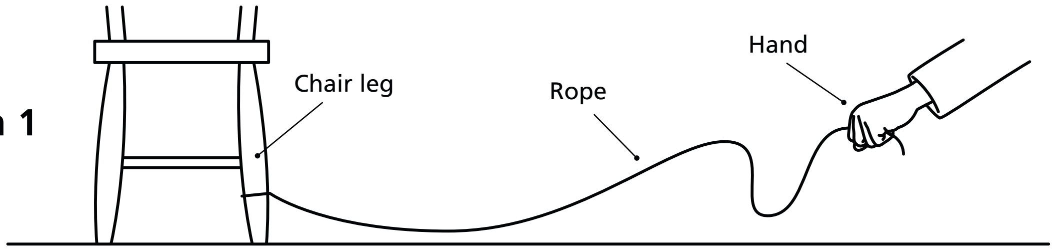
Investigating damping

Try this…

1. Tie a piece of rope to an object close to the floor and rest the rope across the floor.

2. Hold the string taut, and shake the free end with a kind of flicking movement. This will make waves travel along the rope as Diagram 1 shows. (It takes practice!)

Diagram 1

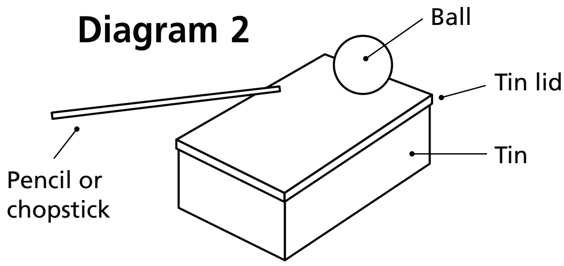


3. You have just made a model of a vibrating object and the sound wave it produces in the air.

Use this model to find out what happens to the wave if the object vibrates strongly and then vibrates weakly. On a separate sheet, write down what you found out.

4. Tap on an empty tin with a pencil or chopstick as Diagram 2 shows. Place different objects onto the tin lid one at a time.

Diagram 2



How do the objects damp the sound of tapping?

✎ ....

5. Which objects were most successful in damping the sound?

✎ ....

6. Which objects were least successful in damping the sound?

✎ ....

7. Remove all the objects from the tin lid. Tap on it while pressing on the lid with your hand. Press with increasing force on the tin lid. What happens to the sound?

✎ ....

6 Teacher's sheet: activity

Based on **pages 14 and 15** of *Changing sounds*

Introducing the activity

(a) Use this activity after the children have studied the unit in the pupil book. You may demonstrate the experiment shown on page 15 (see note (i)). Tell the children they are going to look at the effect of damping in a little more detail.

Using the sheet

(b) Give the children the sheet, let them write their names and form on it, then go through tasks 1 and 2 and let the children try them.

(c) Go through task 3, then let the children try it (see note (ii)).

(d) Go through task 4 with the children, then let them try it (see note (iii)).

(e) Let the children try tasks 5 and 6.

(f) Go through task 7, then let the children try it (see note (iv)).

Completing the activity

(g) Let the children compare their results.

(h) Show the children a drum, such as a snare drum, and ask the children what they could use to damp its sound. Let one of the children test the damper that is suggested.

Conclusion

When the end of the rope is shaken strongly (a large vibration), large waves travel all the way along the rope. When the end of the rope is shaken weakly (small vibration), small waves travel along the rope but do not get to the end.

Objects which cover a large part of the lid damp the sound well. These objects do not have to be particularly heavy.

Objects which cover a small amount of the lid do not damp the sound well. Some of these objects can be quite heavy.

Pressing on the lid not only damps the sound but increases the tension so much that it changes the pitch of the sound.

Teaching notes

(i) If the children did the activity in the introduction to the unit on page 10 you may like to remind them of it now.

(ii) Tell the children that sometimes scientists make models of things they are investigating to understand more fully what happens to them. In this model, the hand is the vibrating object and the rope is the air carrying the sound wave.

(iii) The children should keep tapping as they put each object on the lid and remove it again.

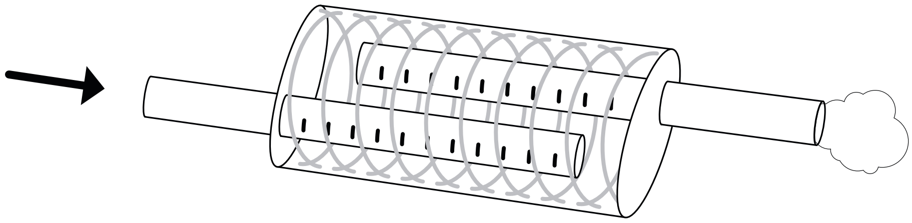
(iv) The children do not need to press so hard on the tin lid that they bend it permanently.

Name: .... Form: ....

See **pages 16 and 17** of *Changing sounds*

Muffling sound

You can muffle, or reduce, sound by using soft materials with lots of air spaces.



Q1. (i) What is the object shown in the diagram? ✎ ....

(ii) The arrow shows where a gas enters the object. Where has it come from?

✎ ....

(iii) What happens to sound energy inside the object?

✎ ....

Q2. Name a place where there is no air. ✎ ....

Q3. Why is double glazing soundproof?

✎ ....

✎ ....

Q4. (i) What are the best materials for soaking up sound?

✎ ....

(ii) What happens to sound in these materials?

✎ ....

Q5. Why can the loud sounds you make in your room be heard in other rooms in the home?

✎ ....

✎ ....

✎ ....

✎ ....

7 Teacher's sheet: comprehension

See **pages 16 and 17** of *Changing sounds*

Answers

1. **(i) Car silencer; (ii) The car engine; (iii) It is changed to heat energy.**

2. **Space, or vacuum.**

3. **Some air is pulled from a gap between sheets of glass so it is more difficult for sound to pass through.**

4. **(i) Soft, spongy or porous materials; (ii) It goes into the holes, bounces around and never comes out.**

5. **Sound travels through walls. Walls are made of solids. Sound travels faster and for longer through solids than they do through the air.**

Complementary work

(a) The children could use secondary sources to find out about who uses ear protection in their work and why.

(b) The children could use secondary sources to find out about an anechoic chamber. This is a room which has all its surfaces covered in baffles of soft materials so that all sound waves are absorbed and none are reflected. It is used to test new microphones and loudspeakers.

Teaching notes

Loud sounds make it difficult for people to think properly, prevent relaxation and can cause permanent ear damage which results in deafness. The ear muffs that are worn by engineers primarily protect the ears from damage but also help the wearer to concentrate.

Noise is considered a form of pollution and legislation is now in place to reduce noise levels in many places.

Muffling is different from damping because it deals with reducing the energy in sound waves, while damping is concerned with reducing the vibrations which cause the sound waves.

All materials are made of tiny particles of matter. In air, the particles of matter swing to and fro as they carry the sound wave along. When the sound wave reaches a wall the particles bang on its surface. If the wall is hard and smooth, the particles bounce off and the sound wave is reflected. If the surface is rough and soft, the movement energy possessed by the particle is absorbed and the particle stops moving. This means that the sound wave is not reflected. The activity in (b) of the complementary work on page 35 may also be useful here to help children understand why soft furnishings can muffle the sound in a room. They can reduce the sound level in a room by 10 decibels.

7

Name: .... **Form:** ....

Based on **pages 16 and 17** of *Changing sounds*

Investigating how materials muffle sound

Try this…

1. Make a collection of materials that you wish to test.

2. Predict which one will muffle sound the most and which will muffle sound the least.

I predict that ✎ .... will muffle sound the most.

I predict that ✎ .... will muffle sound the least.

3. What is the source of sound you are going to use in your investigation?

✎ ....

4. How will you test each material?

✎ ....

5. How will you make your investigation fair?

✎ ....

✎ ....

6. How will you record your results?

✎ ....

7. Ask your teacher to check your plan. If your teacher approves, try your investigation.

Looking at the results.

8. How did your predictions compare with the results?

✎ ....

9. What did the results show?

✎ ....

7 Teacher's sheet: activity

Based on **pages 16 and 17** of *Changing sounds*

Introducing the activity

(a) You may like to begin by placing an alarm clock and a battery powered radio on your table and turning them both on. Make sure that they are making a loud noise, then talk loudly over the top of them. Tell the children that these are just two examples of loud noises. Ask the children for examples of other loud noises (see note (i)). Tell the children that they are going to find out how materials can be made to muffle sounds.

Using the sheet

(b) Give out the sheet, let the children fill in their names and form, then go through task 1 and let the children try it (see note (ii)).

(c) Go through task 2 and let the children try it.

(d) Tell the children that they are to make a plan for the investigation by performing tasks 3 to 6, then let the children try them (see note (iii)).

(e) Let the children try task 7.

(f) Let the children try tasks 8 and 9 (see note (iv)).

Completing the activity

(g) Let the children compare their results.

Conclusion

Materials which are soft and contain many air spaces will muffle sound better than materials which are hard and do not have many air spaces.

Teaching notes

(i) If the children did the activity with the decibel scale in Unit 3, it may be useful to remind them of their results.

(ii) You may want to mention this before the activity so that children could bring in some materials from home.

(iii) The children may choose to use a clock or battery powered radio. Some may wish to use a buzzer they have worked with in their studies of electricity. The material may be wrapped around the object, or it may be more convenient to put the object in a box and cover the box with the material.

When listening for the sound, the listener should sit at the same distance from the object each time. Layers of materials may be added until the sound can no longer be heard. If a radio is used, either music or a 'talk' programme can be used, but not both as music is more difficult to muffle than talking. The results may be recorded in a table which has a column headed 'Material' and one headed 'Number of layers' or 'Thickness (mm)'.

(iv) The children should describe how their predictions and results agree or disagree and should not use terms such as 'OK'.

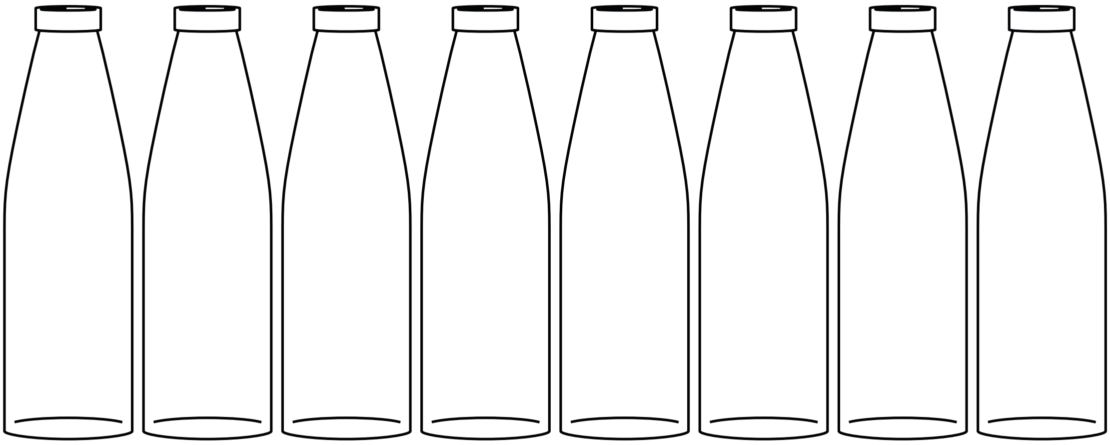
8

Name: .... Form: ....

See **pages 18 and 19** of *Changing sounds*

Making a musical sound

A musical sound is made by a simple, regular vibration.



Q1. (i) Show how you would fill the bottles in the diagram above with water to make them play a scale called an octave.

(ii) Why do you think the scale is called an octave?

✎ ....

(iii) When water is put into a bottle, what else is changed inside the bottle?

✎ ....

Q2. What is the name of the device that produces a single, pure note?

✎ ....

Q3. What is the highness or the lowness of a note called? ✎ ....

Q4. What is the process which builds up a pattern of waves in every musical instrument?

✎ ....

Q5. Why are musical notes pleasant and noise unpleasant?

✎ ....

✎ ....

✎ ....

Answers

1. **(i) The bottles have different amounts of water in them as shown on page 18 of the pupil book; (ii) There are eight notes; (iii) The length of the air space that can vibrate.**
2. **A tuning fork.**
3. **The pitch.**
4. **Resonating.**
5. **Music is produced by instruments which vibrate in a simple, regular way. Noise is made by complicated vibrations.**

Complementary work

(a) The children could use secondary sources to find out about musical instruments through history and how they work.

(b) The children could use secondary sources to find out about musical instruments from around the world.

(c) You could demonstrate the relationship between vibrations and pitch in the following way. Put a finger in a bowl of water and move it slowly to and fro. This will produce a small number of waves moving across the surface. If you wiggle your finger faster, the number of waves moving across the water will rise to match the movement of your finger. You can point out that vibrating objects produce sound waves in a similar way, and those which are produced by slow vibrations make low-pitched sounds while those produced by quick vibrations make high-pitched sounds.

Teaching notes

Children sometimes confuse the loudness of sound with the pitch of sound. Information about loudness is provided on page 27. Here is some information about pitch.

When people talk about the highness or the lowness of a note they are really talking about whether a note is high-pitched or low-pitched. When an object is made to vibrate, it moves to and fro a certain number of times in a second. This number is known as the frequency of the vibration. The vibrating object makes the air around it vibrate at the same rate. This means that the particles in the air move to and fro at the same frequency as the object. It also means that sound waves move through the air at the same frequency as the vibrating object.

You could demonstrate the relationship between the frequency of a vibrating object and the frequency of the waves it produces by trying activity (c) in the complementary work on this page. The children do not need to know the term frequency, but may have heard the word used in connection with tuning a radio. Radio waves also have frequency.

Although sound waves, water waves and radio waves all have crests and troughs and frequency, they are not the same. Sound waves are made by particles of matter moving to and fro and pushing on each other. Water waves are made by particles of water going up and down while the wave passes across the surface. Radio waves belong to a huge group of waves called electromagnetic waves (to which light also belongs). These are waves of electrical and magnetic energy.

8

Name: .... Form: ....

Based on **pages 18 and 19** of *Changing sounds*

Investigating musical notes

Try this…

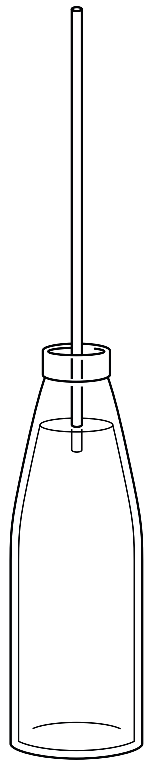
1. Blow up a balloon but do not tie the neck.

2. Tap the balloon three times with a pencil or pen and listen to the note it makes.

3. Let some air out of the balloon, tap it three more times and listen to the note it makes.

4. How does the note change when you let some air out? ✎ ....

5. Take an empty bottle and tap its side with a pencil or pen.



6. Put some water in the bottle and predict how the note will change when you tap it again.

✎ ....

7. Give a reason for your prediction.

✎ ....

8. Tap the bottle and describe how the note changed.

✎ ....

9. Did the change in note match your prediction? Explain your answer.

✎ ....

10. Put a straw in a bottle of water as the diagram shows.

11. Predict what will happen when you blow across the top of the straw as you lower it into the water.

✎ ....

12. Give a reason for your prediction.

✎ ....

13. Blow across the top of the straw and lower the straw into the water as you blow.

14. Record the result and compare it with your prediction.

✎ ....

Teacher's sheet: activity

Based on **pages 18 and 19** of *Changing sounds*

Introducing the activity

(a) Tell the children that scientists often use the results from one experiment to help them predict what will happen in other experiments. In this activity they are going to perform three simple experiments and see if the results from one experiment help in predicting the results of other experiments.

Using the sheet

(b) Give out the sheet and let the children fill in their names and form, then go over tasks 1 to 4 with the children (see note (i)).

(c) Let the children try tasks 1 to 4 (see note (ii)).

(d) Go through tasks 5 and 6, then let the children try them.

(e) Let the children try task 7 (see note (iii)).

(f) Let the children try tasks 8 and 9.

(g) Go through tasks 10 to 12 and let the children try them (see note (iv)).

(h) Let the children try tasks 13 and 14.

Completing the activity

(i) Let the children compare their results and answers (see note (v)).

Conclusion

When an inflated balloon is tapped on a table it makes a high-pitched sound. If some air is released from the balloon, it makes a lower-pitched sound. This suggests that the change in pitch could be due to the reduction in the amount of air.

When an empty bottle is tapped, then water is added and it is tapped again, the pitch of the note increases. This is due to a decrease in the amount of vibrating air in the bottle.

When the top of a straw is blown across while the straw is lowered into water, the pitch of the note changes. This is due to the amount of the air in the straw decreasing.

Teaching notes

(i) It may be useful to blow up a balloon, mime the tapping, let some air out and mime the tapping again to help the children understand what is required.

(ii) Although no reason is asked for the change in note, some children may think that it is due to letting out an amount of air. The change is due to the reduction in the tension of the rubber, but do not discuss it at this stage.

(iii) Some children may suggest that the note will be lower, as it was in the balloon, because the water has pushed some of the air out. Others may refer to some earlier work that they have done on bottles of water and say that the sound will rise due to the shorter column of air in the bottle.

(iv) It may help to mime how the children will blow across the straw as they lower it into the water.

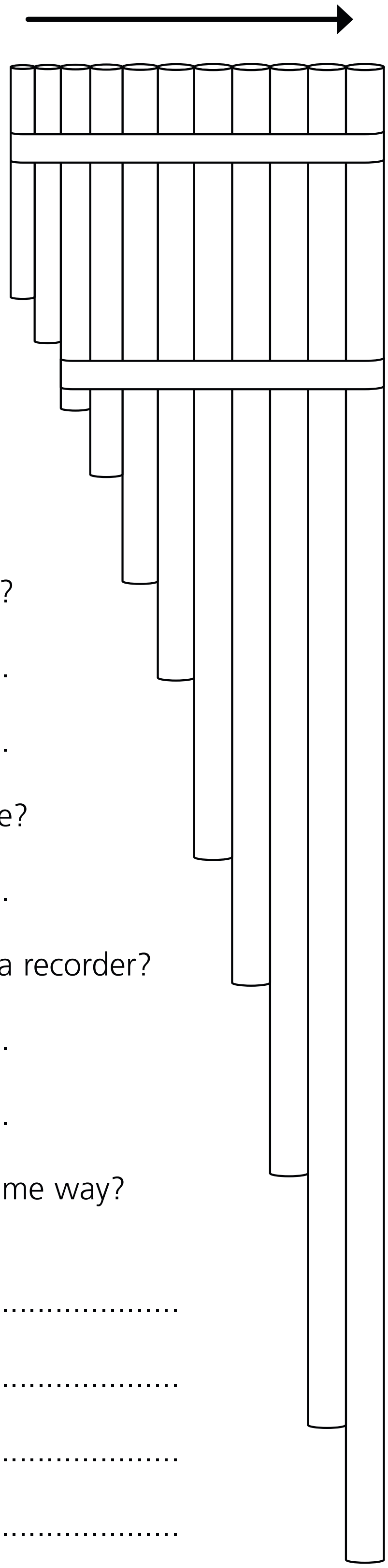
(v) Go through the conclusion carefully and point out that sometimes the results of an experiment may not be interpreted properly and may produce inaccurate predictions to other experiments. Say also that this is normal in science.

9

Name: .... Form: ....

See **pages 20 and 21** of *Changing sounds*

Wind instruments



Wind instruments work by setting a column of air vibrating.

Q1. The picture shows a set of pan pipes.

(i) Shade in the pipe which makes the lowest note.

(ii) Label with an X the pipe which makes the highest note.

(iii) How would the pitch of the sound change if you blew across the pipes by moving your mouth in the direction of the arrow.

Q2. What happens when you blow over the edge of a bottle?

✎ ....

✎ ....

Q3. How could you raise the pitch of a note made by a bottle?

✎ ....

Q4. How can you change the length of the resonating air in a recorder?

✎ ....

✎ ....

Q5. Are the sounds of the flute and the oboe made in the same way? Explain your answer.

✎ ....

✎ ....

✎ ....

✎ ....

✎ ....

✎ ....

9 Teacher's sheet: comprehension

See **pages 20 and 21** of *Changing sounds*

Answers

1. **(i) The longest pipe should be shaded; (ii) The shortest pipe should be labelled with an X; (iii) It would go down.**
2. **You push steady pulses of air down the bottle.**
3. **You could add water to the bottle.**
4. **Open and close the holes on the recorder body.**
5. **No. You blow over the mouthpiece of the flute to set up vibrations in the air. In the oboe, you blow into a reed which then vibrates to make the sound.**

Complementary work

(a) The children could use secondary sources to find out about wind instruments in the orchestra.

Teaching notes

When someone blows into a wind instrument, the air inside the wind instrument vibrates in a special way to produce a sound wave called a standing wave. This is a wave which remains inside the instrument, it does not come out at the end. The length of the standing wave depends on the way the holes are covered up by the fingers or the valves. If the length of the wave is long, the instrument vibrates slowly (at a low frequency) and a low-pitched note is produced. If the standing wave is short, the instrument vibrates quickly (at a high frequency) and the instrument makes a high-pitched note.

When the instrument is blown gently, the wave makes the instrument vibrate weakly, and a quiet, or soft, note is heard. When the instrument is blown strongly, the wave receives so much energy that it makes the instrument vibrate strongly and a loud sound is heard.

In a trombone, the length of the standing wave is changed by changing the position of the slider.

In a recorder, there is a slot below the mouthpiece. When air is blown into the mouthpiece, it hits the slot and makes the column of air in the recorder produce a standing wave. In a flute, the standing wave is produced by blowing over the mouthpiece.

Some instruments, called reed instruments, have one or more pieces of cane (reeds) in the mouthpiece. A clarinet has one reed and an oboe and bassoon have two. The reed causes the vibration which makes the notes. Players of brass instruments, like the trumpet, use the vibration of their lips as air passes through them to make the notes.

9

Name: .... **Form:** ....

Based on **pages 20 and 21** of *Changing sounds*

A simple wind instrument

Try this…

1. Set up a bottle of water and a straw as shown in Diagram 1.

2. Blow across the top of the straw.

3. Set up the bottle of water and straw as shown in Diagram 2.

4. Blow across the top of the straw again.

5. How did the pitch of the note change?

✎ ....

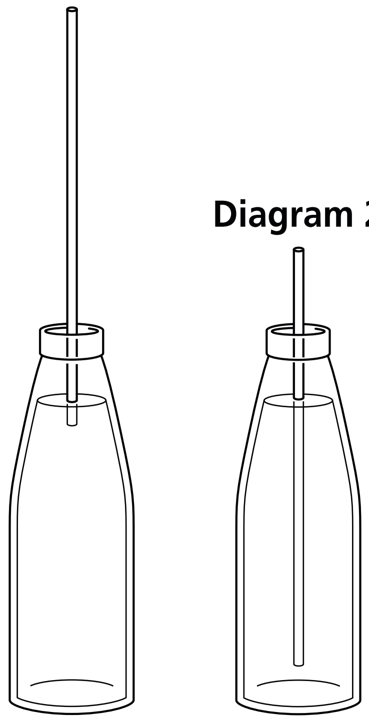
6. How did the amount of air in the straw change? Explain your answer.

✎ ....

✎ ....

Diagram 1

Diagram 2



7. Take five straws and cut them to different lengths.

8. Arrange the straws in order of length and draw the arrangement in this space.

9. Label the straw you think will make the lowest-pitched note and the straw you think will make the highest-pitched note. Explain why you have labelled the straws in this way.

✎ ....

✎ ....

✎ ....

10. Blow over each straw in turn, then compare your results with the prediction made in task 9.

✎ ....

9 Teacher's sheet: activity

Based on **pages 20 and 21** of *Changing sounds*

Introducing the activity

(a) You may use this activity before or after the children have read pages 20 and 21 in the pupil book. You may wish to use this activity as an alternative to the one in Unit 8, or use it to reinforce the work that was done in that activity. Tell the children they are going to make a simple wind instrument.

Using the sheet

(b) Give out the sheet and let the children write their names and form, then go through tasks 1 to 4 and let the children try them (see note (i)).

(c) Go through tasks 5 and 6, then let the children try them (see note (ii)).

(d) Go through tasks 7 and 8, then let the children try them (see note (iii)).

(e) Let the children try tasks 9 and 10 (see note (iv)).

Completing the activity

(f) Let the children compare their results and the performance of their instruments.

Conclusion

When the end of a straw is just dipped into water, there is a long column of air in the straw. When the top of this straw is blown over, the long column of air vibrates and produces a low-pitched note. When the straw is plunged deeper into the water there is a shorter column of air in the straw. When the top of this straw is blown over, the short column of air vibrates and produces a high-pitched note.

A long straw has a longer column of air inside it than a short straw. This means that when its end is blown over, the long column of air vibrates and makes a low-pitched note. The short straw has a short column of air, which vibrates to produce a high-pitched note when the end of the straw is blown over.

Teaching notes

(i) If the children have not done the previous activity they may need a little help. The focus of this part of the activity is to establish that the pitch of the note is related to the length of the column of air in the straw.

(ii) The children should see that the column of air in the straw becomes shorter in task 4 because most of the straw is filled with water. Some children may need help with this.

(iii) The straws should range from long to short. You may like the children to stick them onto two strips of cardboard to make some simple pan pipes. These can then be drawn in the space.

(iv) The longest straw should be labelled as producing the lowest-pitched note, and the shortest straw should be labelled as producing the highest-pitched note. In the explanation, look for a link between the length of the column of air in the tube and the pitch of the note.

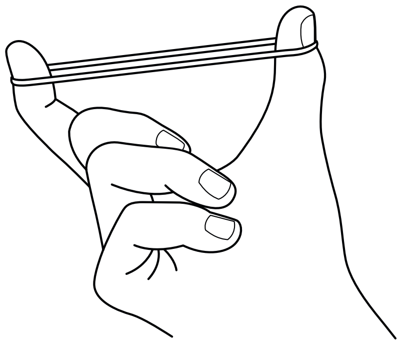
10

Name: .... Form: ....

See **pages 22 and 23** of *Changing sounds*

String instruments

String instruments work by making a string vibrate.



A

B

Q1. The diagram shows an elastic band stretched between two fingers. The band can play a note of a certain pitch.

(i) In space A, draw how the fingers should be arranged to make the elastic band produce a higher-pitched note.

(ii) In space B, draw how the fingers should be arranged to make the elastic band produce a lower-pitched note.

(iii) How does the tension in the band change as you make it play a low-pitched note and then a high-pitched note?

Q2. Name an instrument in which a string is: (a) struck ✎ ....

(b) plucked ✎ ....

Q3. How does the thickness of a string affect the pitch of the note it makes?

Q4. Why does putting a finger on the string of a guitar change the note it plays?

✎ ....

Q5. How is a note produced when you use a bow to play the violin?

✎ ....

✎ ....

✎ ....

✎ ....

10

Teacher's sheet: comprehension

See **pages 22 and 23** of *Changing sounds*

Answers

1. **(i) The fingers should be further apart; (ii) the fingers should be closer together; (iii) The tension increases.**
2. **(a) Piano, (b) guitar.**
3. **The thicker the string, the lower the pitch.**
4. **It changes the length of the string that vibrates.**
5. **The bow is pulled across the string. The string vibrates. The vibrations pass through the bridge to the body. In the body, the sound resonates and gathers strength so that we can hear the note.**

Complementary work

The children could use secondary sources to find out about stringed instruments in the orchestra.

Teaching notes

When a long length of a string is made to vibrate it tends to vibrate slowly. This produces a low-pitched note. If the length of the string is shortened by putting a finger on it and pressing it down onto a board, the shorter length vibrates more quickly when it is plucked or scraped. This produces a higher-pitched note.

Children may ask why all stringed instruments don't sound the same, or why a violin sounds different from a cello. The difference is due to the way the instruments vibrate. When a note is played on a violin, the vibration passes through all parts of the instrument. In addition to the main vibration, which produces the note, there are other vibrations which produce other sound waves called harmonics or overtones. These merge with the main sound wave to produce the particular quality of sound we associate with the sound of a violin. A similar thing happens when a cello is played. In fact, we recognise each instrument not directly by the note it is playing, but by the harmonics which give it its characteristic sound.

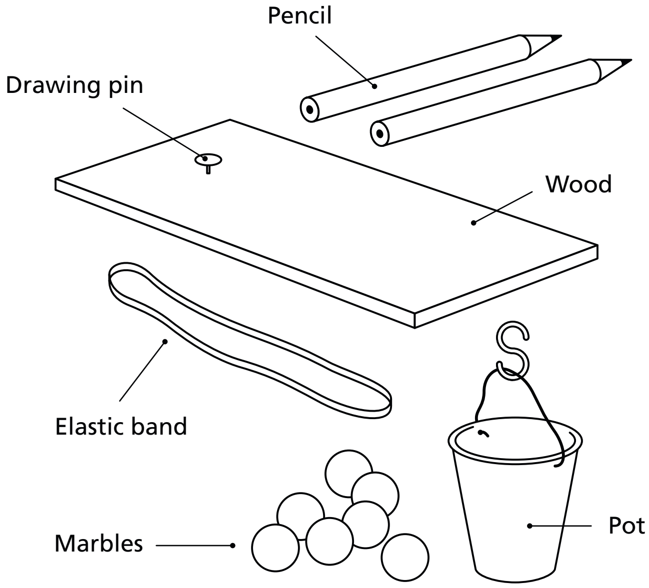
In the introduction to Unit 3, you may have used the piano to show the energy in sound by singing into its open top. The sound waves generated by your voice passed through the air to the piano wires and made some of them start to vibrate and produce sound. Similarly, if you place two similar drums close together, put rice on one and bang the other, the rice bounces on the skin because the skin resonates with the skin of the beaten drum.

10

Name: .... Form: ....

Based on **pages 22 and 23** of *Changing sounds*

Investigating how elastic bands vibrate



Try this…

1. The diagram shows the equipment you need to find out how stretching an elastic band affects the note it makes.

In the box, draw how you would arrange the equipment to make the investigation.

2. On a separate sheet, write down how you would find out how stretching the elastic band affects the note it makes.

3. Predict what the investigation will show.

4. Show your teacher your plan. If your teacher approves, try your investigation.

5. Then make a plan to investigate how the thickness of an elastic band affects the note it makes.

6. Show your teacher your plan. If your teacher approves, try your investigation.

7. Then make a plan to investigate how the length of an elastic band affects the note it makes.

8. Show your teacher your plan. If your teacher approves, try your investigation.

Looking at the results.

9. What do the results of your investigations show?

✎ ....

✎ ....

✎ ....

10

Teacher's sheet: activity

Based on **pages 22 and 23** of *Changing sounds*

Introducing the activity

(a) Tell the children they are going to make three investigations and put the results together to discover how the vibration of an elastic band can be changed.

Using the sheet

(b) Give out the sheet and let the children fill in their names and form, then go through task 1 (see note (i)).

(c) Let the children try tasks 2 to 4 (see note (ii)).

(d) Go through tasks 5 and 6, then let the children try them (see note (iii)).

(e) Go through tasks 7 and 8, then let the children try them (see note (iv)).

(f) Let the children try task 9.

Completing the activity

(g) Let the children compare their results.

Conclusion

As more marbles are added to the yoghurt pot the tension in the elastic band increases (the band is increasingly stretched) and the pitch of the note rises.

When a fair test is made to compare elastic bands of different thickness, but the same length and stretched by the same amount, it is found that the thicker bands give a lower-pitched sound than the thinner bands.

When the length of a stretched elastic band is decreased, the pitch of the note it makes is raised. When the length of the band is increased, the pitch of the note becomes lower.

Teaching notes

(i) The children should draw one end of the elastic band around the drawing pin and the two pencils on the piece of wood under the drawing pin, lifting the elastic band clear of the wood so it is easier to pluck. The other end of the elastic band should be hanging over the end of a table with the pot of marbles hanging from it.

(ii) The plan should state that one marble is placed in the pot, the elastic band plucked and the sound noted. A second marble is then placed in the pot and the process is repeated. The process is repeated until several marbles are in the pot. Care should be taken not to overstretch the elastic band. Check the school safety policy to see if eye protection should be worn.

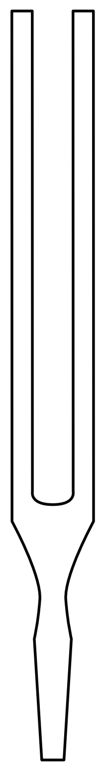
(iii) The plan could state that the drawing pin could be removed from the wood and several elastic bands, which are the same length but different thicknesses, could be stretched over and under the wood. The two pencils could be placed on the top side of the wood, to make a bridge so the bands can be easily plucked.

(iv) The plan could state that one of the elastic bands from the previous investigation is left on the wood, and one of the pencils is removed. A finger may then be placed on the elastic band at different lengths from the pencil, and the band plucked between the pencil and the finger.

QUESTIONS

Name: .... Form: ....

Q1. Here is a tuning fork.



(i) Shade in the parts that move when the tuning fork is struck.

(ii) Draw in arrows to show the directions of the movements.

(iii) What is the word that is used to describe the movements of an object when it makes a sound?

✎ ....

Q2. Where can sound **NOT** travel?

Tick one box: Through a solid ☐ Through space ☐

Through a gas ☐ Through a liquid ☐

Q3. Arif turns on an alarm clock then walks away from it. What happens to the sounds of the clanging alarm bells as he walks away?

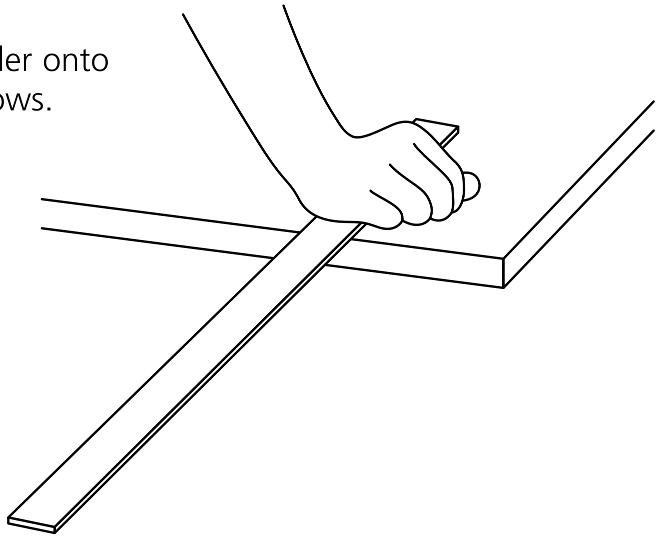
Tick one box: They get louder ☐ They stay the same ☐

They get quieter ☐ They keep getting louder and quieter ☐

QUESTIONS

Name: .... **Form:** ....

Q4. Jane is holding a ruler onto a table as the picture shows.



(i) What happens to the ruler when she bends the end hanging over the table and then lets it go?

✎ ....

(ii) How could Jane get the ruler to make a lower-pitched note?

✎ ....

(iii) How could she get the ruler to make a higher-pitched note?

✎ ....

Q5. Paul looks out of the window and sees Mina ringing her bicycle bell. He can hear the bell.

(i) What did the sound waves travel through to pass from the bell to Paul's ears?

✎ ....

(ii) When did the sound travel fastest?

✎ ....

Q6. Thunder and lightning are made at the same time, so why do you see the lightning flash before you hear the thunder?

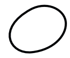
✎ ....

QUESTIONS

Name: .... Form: ....

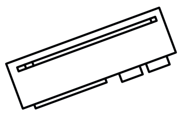
Q7. (i) In Box A, draw how ripples spread out from a pebble when it is dropped in water.

A



(ii) In Box B, draw how sound waves spread out from a radio.

B



(iii) What happens to the height of the ripples and the waves as they spread out?

✎ ....

(iv) What happens to the energy in the ripples and the waves as they spread out?

✎ ....

(v) What happens to the loudness of a sound as it spreads out from the radio?

✎ ....

Q8. The loudness of sounds is measured in units called decibels (dB).

(i) Fill in the table by writing these sounds in the appropriate box.

Normal speech **whisper** **road drill** **vacuum cleaner**

Sound level (dB)	Sound
30	
50	
80	
110	

(ii) Suggest a sound level in decibels for an aeroplane passing low overhead.

✎ ....

QUESTIONS

Name: .... **Form:** ....

Q9. Jane has a portable radio and some pieces of cloth. She wants to find out if the pieces of cloth can reduce the sound made by the radio.

(ii) How could she use the pieces of cloth in the test?

✎ ....

✎ ....

✎ ....

(ii) How could she make the test fair?

✎ ....

✎ ....

✎ ....

(iii) How could Jane find out if bubble wrap was better at reducing noise than the cloth?

✎ ....

✎ ....

✎ ....

Q10. Mina sat up and tapped a pencil on a wooden table. She listened to the sound. She put one ear to the table, tapped and listened again.

(i) How did the sound reach Mina’s ears when she was sitting up?

✎ ....

(ii) How did the sound reach Mina’s ear when she put her ear to the table?

✎ ....

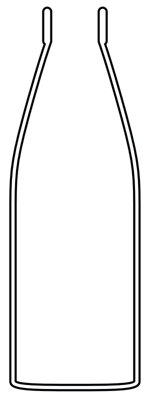
(iii) How did the sound of the tapping change when Mina listened with her ear to the table?

✎ ....

QUESTIONS

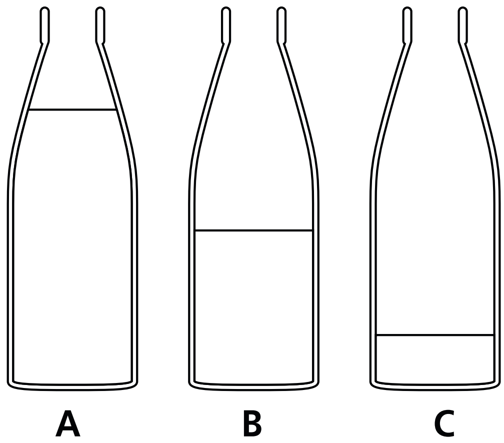
Name: .... **Form:** ....

Q11. Paul has an empty bottle. He wants to add water to it so the bottle will make a high-pitched note when he blows across its top.



(i) Draw in the amount of water he should add.

Arif has set up three bottles of water as the diagram shows.



He blows across the bottle tops, starting with A and ending with C.

(ii) How does the pitch of the sounds change as he moves from bottle A to bottle C?

✎ ....

(iii) Which part of the bottle of water vibrates to make the pitch of the note?

✎ ....

(iv) Arif blows gently, and then more strongly. How does the sound from the bottle change?

✎ ....

Q12. Jane is playing a recorder. What starts the recorder vibrating to make the notes?

Tick one box: Her fingers ☐ The air inside the recorder ☐

The side of the recorder ☐ The holes in the recorder ☐

QUESTIONS

Name: .... **Form:** ....

Q13. Mina is beating a drum

(i) How is the loudness of the drum affected by the way she beats it?

✎ ....

Mina tightens the drum skin then beats it again.

(ii) How has the sound of the drum changed?

✎ ....

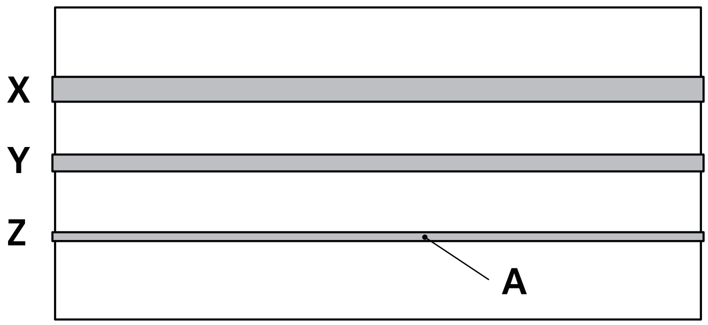
When Mina beats her drum, rice on a nearby drum starts to bounce up and down.

(iii) Why does the rice behave in this way?

✎ ....

✎ ....

Q14. Paul has made a simple guitar with a cardboard box and three elastic bands. The diagram shows how the guitar looks from the top.



(i) Which elastic band gives the lowest pitch when it is plucked? ✎ ....

(ii) What happens to the pitch made by the elastic bands if they are all pulled tighter?

✎ ....

Paul puts his thumb at A on band Z and then plucks the band.

(iii) How does the sound made by this band change?

✎ ....

ANSWERS

1. (i) The tines of the tuning fork should be shaded. *1 mark*
(ii) Arrows should show that the tines moved to and fro. *1 mark*
(iii) Vibration. *1 mark*

2. Through space. *1 mark*

3. They get quieter. *1 mark*

4. (i) It moves up and down. *1 mark*
(ii) Let more of the ruler hang over the end of the table. *1 mark*
(iii) Let less of the ruler hang over the end of the table. *1 mark*

5. (i) Through the air from the bell to the window; through the glass in the window; and through the air from the glass to Paul's ear. *3 marks*
(ii) When it travelled through the glass. *1 mark*

6. Because light travels faster than sound. *1 mark*

7. (i) There should be concentric circles round the pebble. *1 mark*
(ii) There should be concentric circles round the radio. *1 mark*
(iii) The heights decrease. *1 mark*
(iv) The energy decreases. *1 mark*
(v) The sound becomes quieter. *1 mark*

8. (i) 30dB = whisper, 50dB = normal speech, 80dB = vacuum cleaner, 110dB = road drill. *4 marks*
(ii) Over 110dB or about 120dB. *1 mark*

9. (i) Turn on the radio and put it in the box. *1 mark*
(ii) Put one piece of cloth round the box and listen to the sound, add another piece of cloth and listen again. Keep adding pieces of cloth until the sound cannot be heard. *1 mark*
(iii) She could sit the same distance from the box each time to listen to the sound. *1 mark*
(iv) She could repeat the experiment with bubble wrap and compare how many pieces had to be added until the radio could not be heard. *1 mark*

10. (i) Through the air. *1 mark*
(ii) Through the wood. *1 mark*
(iii) It was louder. *1 mark*

11. (i) The water level should be up to the top third of the bottle. *1 mark*
(ii) It goes down. *1 mark*
(iii) The column of air in the bottle. *1 mark*
(iv) The sound becomes louder. *1 mark*

12. The air inside the recorder. *1 mark*

13. (i) The harder she beats the drum, the louder it sounds. *1 mark*
(ii) Its pitch gets higher. *1 mark*
(iii) Sound waves pass through the air from Mina's drum and make the second drum vibrate too (resonate). This makes the rice bounce up and down. *2 marks*

14. (i) X. *1 mark*
(ii) The pitch gets higher. *1 mark*
(iii) The pitch gets higher. *1 mark*

Total marks: 42